Science and Technology

Program Mission

The Environmental Management (EM) cleanup effort is expensive, technologically complex, closely regulated, and relatively unique in the world. Achieving the goal of cost effective cleanup requires targeted investments in science and technology to respond to hundreds of environmental problems identified by cleanup project managers at the affected sites. The EM Office of Science and Technology conducts a national program that provides the full range of resources and capabilities--from basic research through development, demonstration and technical and deployment assistance–that are needed to deliver and support fully developed, deployable scientific and technological solutions to Environmental Management cleanup and long-term environmental stewardship problems.

Program Goal

Science and Technology activities are performed through teams that address DOE's major environmental problem areas. Referred to as "Focus Areas," these are: Mixed Waste; Radioactive Tank Waste; Subsurface Contaminants; Deactivation and Decommissioning; and Nuclear Materials (formerly Plutonium Stabilization). Science and Technology provides users with the most efficient, effective environmental cleanup technologies and technical solutions possible and on a schedule that enables achieving cleanup and bringing into compliance the majority of the DOE complex by 2006. This is accomplished through direct project manager participation. Investments in science and technology are planned and managed in an interactive, coordinated, participatory relationship with EM cleanup project managers and stakeholders.

Program Objectives

The complexity and duration of the EM cleanup effort requires carefully prioritized and sequenced science and technology investments. Science and Technology's work scope priorities are established through a multi-attribute decision model that prioritizes EM's technology needs and drives investments for science and technology using the input from the sites' baseline planning data. No activity is funded unless it:

- **Addresses one of EM's highest priority needs** -- Conduct scientific research and technology development on highest priority end-user needs, including those on the critical path to site closure and those representing major technology gaps in project completion.
- **Reduces the cost of EM's costliest cleanup projects** -- Direct funds to activities where the potential for significant cost reduction is highest.
- **Reduces EM's technological risk** -- Direct funds to activities that reduce programmatic risk–where critical cleanup activities will not be completed on time or within budget due to a technology deficiency.

- **Reduces risk to public health and safety –** Direct funds to activities that will reduce present and future risk through innovative methods that reduce, mitigate, or contain radioactive and hazardous materials and their potential release to the environment.
- **Accelerates and increases technology deployment by bridging the gap between development and use** -- Involve users in all phases of Science and Technology planning and decision making activities and bridge the gap between development and use to ensure that new technology is rapidly deployed through site-based technical assistance.
- **Contributes to a targeted scientific research agenda** -- Conduct, in partnership with DOE's Office of Science and in tandem with the "Focus Areas," a long-term basic research program that will result in transformational or breakthrough approaches for solving the Department's most intractable environmental problems.

Performance Measures

The success of the Science and Technology program is currently measured by:

- The number of technologies or technology systems (25) demonstrated that meet performance specification-based needs as identified by the Site Technology Coordinating Groups.
- The number of technologies or technology systems (32) made ready for implementation with cost and engineering performance data.
- The number of deployments (60) of alternative technology in cleanup activities, an Environmental Management corporate measure shared by the EM user organizations, which are responsible for technology selections.

In addition to the existing corporate measure on number of deployments, Science and Technology has developed new "value-added" measures that will be tracked concurrently with the technology demonstrations and technologies made ready for implementation measures. These measures will assess how well the science and technology investments are managed and how effectively the results of the science and technology activities are being used. Metrics for these additional three measures are currently being established in the outyears:

- Number of high priority site needs being addressed by Science and Technology activities.
- Reduction in programmatic risk as a result of Science and Technology activities.
- Life cycle cost savings as a result of Science and Technology activities.

Budget Milestones

- # Complete Large Scale Demonstration Project 5 - Tritium Decontamination and Decommissioning at Mound (September 2001).
- # Deploy Transuranic Optimized Measurement System at the Savannah River Site to assay and segregate suspect transuranic waste (June 2001).
- # Complete Large Scale Demonstration Project 4 - Decontamination, Treatment, and Size Reduction of Transuranic Waste at Los Alamos National Laboratory (September 2001).
- # Complete demonstration of HANDS-55 repackaging system at the Savannah River Site (July 2001).
- # Deploy a vacuum transfer system at Fernald for repackaging enriched uranium (July 2001).
- # Demonstrate removal of plutonium surface contamination from uranium to enable shipment of components (July 2001).
- # Deploy CTEN at the Radio-assay and Non-destructive Testing (RANT) Facility at Los Alamos National Laboratory (June 2000).
- # Demonstrate the Transuranic Optimized Measurement System Assay System at the Savannah River Site (April 2000).
- # Complete Unit Operations Demo to Support Final Design of Selected Savannah River Site Salt Cs Removal Process (September 2001).
- # Deploy Alternative High-Efficiency Particulate Air Filter Technology at the Savannah River Site (September 2001).
- # Demonstrate Enhanced Pit Operations Technology for Tank Farm Valve Pits at Hanford (September 2001).
- # Complete Large Scale Demonstration Project for Deactivation of Highly Enriched Uranium Processing Facility at the Savannah River Site (March 2000).
- # Deploy Atomic Energy Authority (AEA) Grout formulation for Idaho National Environmental and Engineering Laboratory Newly Generated Liquid Wastes (September 2000).
- # Complete Fuel Storage Pools and Associated Structures Large Scale Demonstration Project with Demo of at least 4 new and innovative decontamination and decommissioning technologies (December 2000).
- # Deploy Dynamic Underground Stripping Technology at Savannah River with Steam Injection Operation (June 2000).
- # Deploy innovative technology to reduce number of confinement layers in Idaho National Environmental and Engineering Laboratory transuranic waste drums for shipment (June 2000).

- # Award renewals for FY 1996 and FY 1997 basic science projects (September 2000).
- # Conduct Second National Environmental Management Science Program Workshop (April 2000).
- # Complete long-term problem specific research agendas for high level waste and decontamination and decommissioning (March 2001).
- # Deploy heel removal technology for Savannah River Site Tank 19 (July 2000).
- # Demonstrate industry technologies for waste transfer line unplugging at Florida International University (FIU) (September 2000).
- # Deploy Consolidated Incinerator Facility Modulator Evaporator at Savannah River (July 2000).
- # Deploy multi-point injection grouting in Oak Ridge Reservation Old Hydrofracture Tanks (June 2000)

Significant Accomplishments and Program Shifts

- # During FY 2000, moved to a fully Focus Area-centered approach where all research, development, demonstration, and technical and deployment assistance activities are managed through the established Focus Areas, including crosscutting programs, such as Industry and University Programs and Western Environmental Technology Office activities. Lead laboratories have also been established by each Focus Area to enhance their technical expertise.
- # For FY 2001, emphasis will be placed on transitioning research results from the Environmental Management Science Program into the applied research and development phase through the established Focus Areas to address mid- to long-term cleanup needs.
- # Disseminate research results from early successes of researchers funded through the Environmental Management Science Program. Continue support of quality scientific resources both in the United States and internationally. Scientists that have been funded through the Environmental Management Science Program represent 90 universities, 13 Department of Energy laboratories, and 22 other governmental and private laboratories located in 38 states and the District of Columbia, United Kingdom, Canada, Australia, Russia and the Czech Republic. Of the 274 research awards, 147 are or were collaborative efforts involving funding at two or more institutions.
- # Awarded scientific research projects in FY 1999 in the areas of subsurface contamination/vadose zone (31 awards) and effects of low dose radiation (8 awards). Research focused on subsurface contamination/vadose zone issues will assist the Department in addressing problems identified at the Hanford site and other DOE sites with similar problems. Research on the effects of low dose radiation will help to identify potential health and ecological effects from exposures and risks from low dose radiation. Awards were initiated in September 1999. In FY 2000, conduct a competition to renew 20 to 30 of the most promising research projects originally funded in FY 1996 and FY 1997.

- During FY 2000, expanded the Plutonium Stabilization and Disposition Focus Area (now the Nuclear Materials Focus Area) to address all nuclear material needs and requirements within EM purview.
- Complete demonstration during FY 2001 of an inexpensive means of reducing the flammable gas concentrations in drums of waste to be shipped to the Waste Isolation Pilot Plant. This process (Hydrogen Gas Getters), enables meeting the limits set forth in the TRUPACT-II Safety Analysis Report and allows larger amounts of waste to be contained in each drum.
- Complete in FY 2000, demonstration and deployment of innovative technologies for underwater inspection and equipment size reduction, surface characterization and decontamination, structural dismantlement, and sludge/debris removal at the Idaho National Engineering and Environmental Laboratory fuel pools.
- In FY 2001, complete the Los Alamos National Laboratory Transuranic Waste Characterization and Disposition Large-Scale Demonstration and Deployment Project. Innovative technologies for characterization, decontamination, size reduction, and packaging of transuranic waste, including plutonium contaminated gloveboxes, will be showcased.
- Demonstrate and deploy in FY 2001, tank waste retrieval technologies enabling continued processing plant feed delivery and tank closure activities at Savannah River Site, West Valley Demonstration Project, Oak Ridge and Hanford.
- Demonstrate and recommend in FY 2001 designs for the next generation melter for Savannah River Site and the high-level waste melter for Idaho National Engineering and Environmental Laboratory to reduce costs of processing and enable overall waste system design.
- Continue multi-year tasks performed in cooperation with the U.S. Environmental Protection Agency to improve landfill caps, cover, and barriers to prevent the migration of wastes from DOE sites. Data from these successful demonstrations will be incorporated into national landfill cover design guidance.
- Continue accelerated site technology deployment (ASTD) projects initiated in FY 1999 and competitively select new accelerated site technology deployment projects in FY 2000. These projects are designed to accelerate widespread deployment of innovative technologies by providing cost and performance documentation. Aggressive use of alternative technologies in which the Department has invested optimizes the cost savings they enable.
- In FY 2000 and FY 2001, conduct long-term stewardship activities related to more reliable and cost-effective characterization and monitoring technologies and approaches; long-term stewardship information management; waste form stabilization and durability; risk analyses and communication; and related research and development activities. Long-term stewardship will ensure human health and the environment are protected after cleanup is completed; sites are closed; waste is emplaced for disposal; and/or facilities are stabilized for long periods awaiting possible further remediation; sites are monitored to detect contaminant migration, site containment and that maintenance of barriers and treatment facilities occur in a safe, timely and cost effective manner.

Uncertainties are inherent in any research program, and the allocations of funding requested below represent the best estimates at the time this budget was formulated. It is possible that as circumstances change, or new

higher-priority risks are identified by the sites, it may be necessary to redirect funds within the Science and Technology program categories to accommodate these changes.

FY 2001Budget Summary [a]

	(dollars in thousands)		
	FY 1999	FY 2000	FY 2001
Mixed Waste, Characterization, Treatment and Disposal Focus Area . . .	28,087	27,430	28,002

The Mixed Waste, Characterization, Treatment, and Disposal Focus Area provides technical and engineering solutions for supporting effective, efficient mixed waste treatment technology systems. Site Treatment Plans identified 165,000 m^3 of mixed and transuranic waste in storage that includes over 1,437 mixed waste streams at 40 sites. The Environmental Management sites' baseline planning data has identified 60 high priority technology needs in the mixed and transuranic waste areas. It also identified 88 waste streams with high technology risk. With the funding provided, this Focus Area will assist in the deployment of alternative technologies at individual sites and implement and maintain sound program management and integration processes. The Mixed Waste, Characterization, Treatment, and Disposal Focus Area includes the following activities:

Material Handling and Characterization Solutions (FY 2001 funding $14,028,000) are being developed to characterize radionuclide components in boxes destined for disposal at Waste Isolation Pilot Plant or other subtitle C facility, to enhance payload capacity of transuranic waste containers, and to develop automated handling systems for mixed waste material during characterization, treatment, packaging, and disposal.

Non-Thermal Treatment Solutions (FY 2001 funding $9,406,000) are being developed as an alternative to high temperature treatment systems because of the low risk and high regulatory and public acceptance. Activities will include alternative oxidation technology treatment and stabilization alternatives for plutonium 238 contaminated waste and polychlorinated biphenyl mixed waste.

Thermal Treatment Enabling Solutions (FY 2001 funding $4,568,000) are being developed to address technical concerns that will be created by the Maximum Achievable Control Technology for Hazardous Waste Combustors Rule including emissions of mercury, dioxins and furans, and particulate matter.

[a] The following seven pages are a synopsis of the budget request for the Office of Science and Technology and is provided for ancillary information.

	(dollars in thousands)		
	FY 1999	FY 2000	FY 2001
Radioactive Tank Waste Remediation Focus Area	45,273	45,002	56,936

The Radioactive Tank Waste Remediation Focus Area addresses 44 high priority needs in the development and deployment of technologies to remove high-level waste in over 280 large radioactive and other miscellaneous underground storage tanks across DOE containing over 90 million gallons of waste, and process the waste for final disposal. There are 37 streams at 4 sites. Seventeen of these streams are associated with a high technology risk. Closure of these tanks will mitigate further risks to groundwater and surrounding populations, and contribute significantly to mortgage reduction. Within the funding provided, the Radioactive Tank Waste Remediation Focus Area will assist individual sites in the deployment of alternative technologies to reduce risk and cost, enable baseline tank remediation to be implemented, and accelerate cleanup at those sites. The Radioactive Tank Waste Remediation Focus Area includes the following activities:

Tank Waste Retrieval and Closure (FY 2001 funding $30,106,000) will focus on systems to retrieve and transfer sludges and tank waste residues to enable continued processors and tank closure at INEEL, OR, SR, Hanford and West Valley. Techniques will be developed and deployed to ensure tank integrity prior to and during retrieval operations, reduce risk of transfer line plugging, improve tank farm operations to support retrieval, and enable tank waste stabilization for ultimate tank closure.

Tank Waste Pretreatment and Immobilization (FY 2001 funding $26,830,000) technology will be developed and deployed to improve high-level waste immobilization processes through increased waste loading, new canister decontamination methods, and advanced melter design. Development and demonstration activities will provide alternative paths to salt waste treatment to replace in-tank precipitation at Savannah River, and enable integrated flow sheet design for pretreatment and immobilization at Idaho.

	(dollars in thousands)		
	FY 1999	FY 2000	FY 2001
Subsurface Contaminants Focus Area	40,182	41,310	37,203

The Subsurface Contaminants Focus Area addresses technological solutions for the 5,700 known DOE groundwater plumes that involve 475 billion gallons of contaminated water and 75 million m^3 of contaminated soil. Three million m^3 of leaching wastes buried in landfills, trenches, and spill areas continue to feed these plumes. The EM sites' baseline planning data has identified 68 high priority needs, and 18 streams (of 369 total streams at 37 sites) with high technology risks within the Environmental Restoration problem area. The Subsurface Contaminants Focus Area divides its work to solve these problems into three areas: Destruction of Dense Non-Aqueous Phase Liquids, primarily chlorinated organic solvents that are now polluting groundwater from localized underground pools; containment or stabilization of concentrated waste in landfills, trenches, and

around leaking high-level waste tanks; and treatment or stabilization of hazardous metals and radionuclides dispersed in soils and groundwater. Within the funding provided, this Focus Area will assist individual sites in the development and deployment of alternative technologies to reduce risk and cost, and accelerate cleanup at those sites.

The Subsurface Contaminants Focus Area includes the following activities:

Dense Non-Aqueous Phase Liquids (FY 2001 funding $12,357,000) constitute a generic class of particularly difficult to locate, quantify, and treat or destroy organics that contaminate both the vadose and saturated zones at many DOE sites. Activities will focus on better understanding the long-term movement and fate of these contaminants to better design treatment strategies. Treatment systems will be demonstrated and deployed, including advanced bioremediation and natural attenuation, in-situ passive and reactive barriers, and in-situ treatment technologies applicable to a broad range of geologies in the vadose and saturated zones, including deep access.

Source Term Containment/Source Term Remediation (FY 2001 funding $12,087,000) prevents the further spread of contaminants to limit associated risks and cleanup costs. Technologies for deep barrier placement, improved longer life surface caps, landfill hot spot removal or stabilization, and verification monitoring will be demonstrated and deployed.

Metals and Radionuclides in the Vadose and Saturated Zones (FY 2001 funding $12,759,000) cannot be destroyed and therefore, must be either stabilized or removed. Efforts will continue to develop improved characterization, monitoring and modeling techniques and to verify the performance of reactive and passive barrier systems at Rocky Flats and Oak Ridge. Technologies will be deployed to chemically stabilize or remove contaminants at Hanford, Mound and Albuquerque.

(dollars in thousands)

	FY 1999	FY 2000	FY 2001
Deactivation and Decommissioning Focus Area	28,795	27,235	18,372

The Deactivation and Decommissioning Focus Area develops, demonstrates, and facilitates implementation and deployment of efficient and cost effective technologies through a series of Large Scale Demonstration and Deployment Projects which address real needs pertaining to the 20,000 radiologically/hazardous waste contaminated buildings and facilities. The near-term goal is to reduce the EM deactivation and decommissioning mortgage by 25 percent in the near term and 50 percent in the long-term (i.e. post 2006) or a net reduction of approximately $1,000,000,000. The EM sites' baseline planning data has identified 24 high priority needs. Within the funding provided, this focus area will assist individual sites in the deployment of alternative technologies to reduce risk and cost, and accelerate cleanup at these sites. The Deactivation and Decommissioning Focus Area includes the following activities:

Reactor Facilities (FY 2001 funding $3,645,000) technologies will be demonstrated and deployed to address underwater visual inspection, characterization and dismantlement, as well as removal and treatment of highly contaminated fuel pool sludges, debris and water. Technologies will be demonstrated and

deployed to facilitate decontamination and decommissioning of the 14 surplus production reactors across the DOE complex to a degree such that they can be put in interim safe storage for up to 50 years.

Radionuclide Separation Facilities (FY 2001 funding $9,462,000) Improved technologies are required to deactivate and decommission radionuclide separation facilities, including gaseous diffusion plants, chemical separation facilities, uranium recycling facilities, lithium enrichment facilities, heavy water production facilities and tritium production facilities. Technologies to characterize, separate and decontaminate metals will be demonstrated and deployed.

Fuel and Weapons Component Fabrication Facilities (FY 2001 funding $5,265,000) Improved and innovative technologies are required to deactivate and decommission fuel and weapons component fabrication facilities including uranium milling and refining facilities, fuel and target fabrication facilities, weapons component fabrication facilities and weapons assembly and dismantlement, modification and maintenance facilities. Improved and innovative technologies will be demonstrated and deployed to address building deactivation and decommissioning and metal/concrete waste disposal/recycling at tritium contaminated facilities.

(dollars in thousands)

	FY 1999	FY 2000	FY 2001
Nuclear Materials Focus Area	6,035	4,135	8,641

The Nuclear Materials Focus Area supports the safe management and expeditious stabilization of nuclear materials currently under the purview of the Office of Environmental Management. Technical solutions to the broad range of challenges associated with management of nuclear materials will be identified and provided to the EM complex. The EM sites' baseline planning data has identified 36 high priority needs in the nuclear materials problem area. Within the funding provided, the Nuclear Materials Focus Area will assist individual sites in the deployment of alternative technologies to reduce risk, cost, and accelerate cleanup at these sites.

Stabilization Technology Development (FY 2001 funding of $5,349,000) will focus on developing improved processes to stabilize plutonium (approximately 20 metric tons) left in the weapons production pipelines in various storage configurations and plutonium residues (approximately 150 metric tons) and materials processing techniques to address the widely varying chemical and physical forms of EM nuclear materials.

Packaging, Transportation and Storage Technologies (FY 2001 funding of $3,292,000) Activities will focus on developing technologies for the packaging and transportation of nuclear materials across the complex. Some nuclear materials exist in chemical and physical forms that were not historically transported in the complex. Their transportation is now necessary due to the lack of processing capabilities at many sites. Technology development which addresses long-term storage needs will also be pursued.

	(dollars in thousands)		
	FY 1999	FY 2000	FY 2001
Environmental Systems Research and Analysis	13,500	22,500	0

The Idaho National Engineering and Environmental Laboratory will support EM in its long-term cleanup mission by developing and maintaining critical environmental science capabilities, environmental research, and support for the transition of basic science to engineering applications and problem solution. In addition, systems engineering activities will be used to refine baselines for EM waste management, spent nuclear fuel, and nuclear materials disposition, and identify new opportunities to accomplish more efficient and cost effective cleanup and closure of DOE sites. EM integration activity is being conducted utilizing multi-site teams to develop, evaluate, and recommend alternatives to existing baselines for waste management, spent nuclear fuel, and nuclear materials disposition.

Beginning in FY 2001, this activity will be funded within the Idaho Defense Post 2006 Completion and Site Project Completion accounts.

	(dollars in thousands)		
	FY 1999	FY 2000	FY 2001
Technology Acceptance and Support	20,005	19,719	16,894

The Technology Acceptance and Support program supports the broad acceptance and deployment of emerging technologies; the collection, analysis, and communication of project specific data and program information; facilitates the implementation of sound business management practices; interacts with the international scientific and technical community; and assists in science and technology laboratory management policy and review.

Program Information, Review, and Analysis (FY 2001 funding $8,365,000) activities will focus on Office of Science and Technology strategic planning; developing and implementing laboratory management policy and review; ongoing programmatic and technology reviews; and information systems, communication products, and analysis. Activities are focused on providing and improving effective and credible information and information management systems, communications planning and products, business management support, independent program and technology assessments and peer reviews, and assistance to and consolidation of field cost savings analysis.

Regulatory and Site Acceptance (FY 2001 funding $5,929,000) contributes to overall Environmental Management mortgage reduction by helping states establish acceptance verification protocols and reciprocity guidelines to expedite multi-state permitting and multi-site deployment. Site acceptance is facilitated by identifying site needs to the Focus Areas as early as possible to ensure the Focus Areas are

working on the right problems. Site participation in technology deployment planning and workshops to encourage use of innovative technologies are also included. Technology transfer and commercialization activities will be continued.

International Technology Coordination (FY 2001 funding $600,000) activities will focus on the facilitation of international technical workshops and oversight of Office of Science and Technology international activities.

Safety Testing (FY 2001 funding $2,000,000) will focus on worker health and safety assessments of high-impact environmental technologies.

(dollars in thousands)

	FY 1999	FY 2000	FY 2001
Small Business Innovative Research Program (Technology Development)	0	3,800	1,500

Funding is requested for the Small Business Innovative Research assessment in accordance with Public Law 102-564, which mandates a percentage of all research and development dollars be set aside for grants to small businesses. Once funding is appropriated, it is transferred to the DOE Office of Science for award and administration of grants to small businesses.

(dollars in thousands)

	FY 1999	FY 2000	FY 2001
Environmental Management Science Program	45,838 [a]	32,000 [a]	27,000 [a]

The EM Science Program was created to stimulate basic research and technology development for cleanup of the Nation's nuclear weapons complex. The program's objective is to improve the effectiveness of the cleanup effort over the long-term. The importance of basic scientific research to the cleanup mission was established in the Secretary of Energy Advisory Board (Galvin) Report: "There is a particular need for long-term, basic research in disciplines related to environmental cleanup...Adopting a science-based approach that includes supporting development of technologies and expertise...could lead to both reduced cleanup costs and smaller environmental impacts at existing sites and to the development of a scientific foundation for advances in environmental technologies."

The Science Program represents a partnership between DOE’s Office of Science and the EM program. The Office of Science manages the solicitation of proposals and scientific review process. EM ensures that the research is relevant to the Department's cleanup problems. Science projects funded to date focus on critical

[a] Includes Small Business Innovative Research assessment, in the amount of $765,000 in FY 2000 and $675,000 in FY 2001.

problems identified through: 1) workshops at Hanford, Savannah River, Oak Ridge, and Idaho; 2) a complex-wide needs survey; 3) solicitation of science research needs that address problems as identified by the EM sites' baseline planning data; 4) independent development of long-term research agendas; and 5) a systems engineering analysis. To date, of the 274 projects selected, 113 focus on science needed to improve subsurface contamination/vadose zone; 68 focus on finding better ways to treat and destroy high-level waste; 32 focus on waste containing a mixture of radioactive and other hazardous materials (mixed waste); 26 focus on better understanding the health and ecological effects associated with environmental cleanup options; 8 address the materials used in weapons production (nuclear materials); 22 projects focus on technical problems with facility deactivation and decommissioning, and the remaining 5 projects focus on spent nuclear fuel stabilization and disposal. In FY 1999, 31 new awards were made to address subsurface contaminated vadose zone issues identified at the Hanford site and other DOE sites with similar problems. Eight awards were made to address the effects of low dose radiation which will assist the Department to understand and identify health and ecological effects form exposures and risks from low dose radiation. This competitive program has been effective in establishing a link between the EM program and the scientific community. Thirteen of DOE's national laboratories and 90 academic institutions, and 22 other Federal laboratories and industrial organizations currently participate in the program. FY 1999 is the last year of funding for the first 136 grants awarded by the program, a $115,000,000 investment, FY 2000 is the last year of funding for the 66 projects funded in FY 1997, a $46,400,000 investment; FY 2001 is the last year of funding for the 33 projects funded in FY 1998, a $20,500,000 investment; and FY 2002 is the last year of funding for the 39 projects funded in FY 1999, a $32,811,239 investment.

(dollars in thousands)

	FY 1999	FY 2000	FY 2001
Environmental Management Risk Policy Program	9,000	5,000	2,000

Risk informed decision making is critical to the success of the EM program. The EM Risk Policy Program provides the analytical framework and technical support necessary for credible, risk-based environmental decisions. The program provides technical support to EM field elements for developing and implementing site-specific processes for risk analysis, risk management, risk communication and priority setting initiatives; technical peer review and comments on scientific and technical risk materials; development of new risk tools and training; and integration of risk information into the planning process. This support helps to ensure that the right information is available to prioritize and fund high risk projects so that risk to workers, the public and the environment decrease over time.

Funding Profile

(dollars in thousands)

	FY 1999 Current Appropriation	FY 2000 Original Appropriation	FY 2000 Adjustments	FY 2000 Current Appropriation	FY 2001 Request
Mixed Waste, Characterization, Treatment, and Disposal Focus Area	28,087	27,881	(451)	27,430	28,002
Radioactive Tank Waste Remediation Focus Area	45,273	45,736	(734)	45,002	56,936
Subsurface Contaminants Focus Area	40,182	41,973	(663)	41,310	37,203
Deactivation and Decommissioning Focus Area	28,795	27,686	(451)	27,235	18,372
Nuclear Materials Focus Area	6,035	4,205	(70)	4,135	8,641
Environmental Systems Research and Analysis	13,500	22,500	0	22,500	0
Technology Acceptance and Support	20,005	19,719	0	19,719	16,894
Small Business Innovative Research Program (Technology Development)	0 [a]	3,800	0	3,800	1,500
Environmental Management Science Program	45,838 [b]	32,000	0	32,000	27,000
Environmental Management Risk Policy Program	9,000	5,000	0	5,000	2,000
Subtotal, Science and Technology	236,715	230,500	-2,369 [c]	228,131	196,548
FFTF Reprogramming Sources	0	0	1,282	1,282	0
Total, Science and Technology	236,715	230,500	-1,087	229,413 [d]	196,548 [d]

Public Law Authorizations:

Public Law 95-91, “Department of Energy Organization Act (1977)”

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[a] $2,404,000 transferred to DOE Office of Science for award and administration of grants to small businesses.

[b] $1,162,000 transferred to DOE Office of Science for award and administration of grants to small businesses.

[c] Reflects congressional rescission and reduction for sources to fund the Fast Flux Test Reactor Reprogramming.

[d] Final distribution of funds by program category in FY 2000 and FY 2001 could change based upon changing priorities, and final receipt, review, selection, and award of technical proposals.

(dollars in thousands)

FY 1999 Current Appropriation	FY 2000 Original Appropriation	FY 2000 Adjustments	FY 2000 Current Appropriation	FY 2001 Request

Public Law 106-60, “The Energy and Water Development Appropriations Act, 2000"

Public Law 106-65, “The National Defense Authorization Act for Fiscal Year 2000"

Public Law 103-62, “Government Performance and Results Act of 1993"

Funding by Site

(dollars in thousands)

	FY 1999	FY 2000	FY 2001	$ Change	% Change
Albuquerque Operations Office					
Los Alamos National Laboratory (NM)	7,424	6,304	3,442	-2,862	-45.4%
Sandia National Laboratory (NM)	7,586	6,699	5,608	-1,091	-16.3%
Lovelace Biomedical and Environmental Research Institute (CO)	192	0	0	0	<999.9%
Mid-West Research Institute (CO)	191	0	0	0	<999.9%
Grand Junction Project Office (CO)	1,699	165	0	-165	-100.0%
Albuquerque Operations Office (NM)	2,086	1,509	2,307	798	52.9%
University Robotics Program (ALO)	4,000	4,000	4,000	0	0.0%
Total, Albuquerque Operations Office	23,178	18,677	15,357	-3,320	-17.8%
Chicago Operations Office					
Ames Laboratory (IA)	1,293	610	0	-610	-100.0%
Argonne National Laboratory (West) (ID)	4,654	2,203	937	-1,266	-57.5%
Brookhaven National Laboratory (NY)	1,447	1,585	536	-1,049	-66.2%
Chicago Operations Office (IL)	5,676	5,080	5,540	460	9.1%
Total, Chicago Operations Office	13,070	9,478	7,013	-2,465	-26.0%
Idaho Operations Office					
Idaho National Engineering and Environmental Laboratory (ID)	21,610	31,312	10,229	-21,083	-67.3%
Idaho Operations Office (ID)	20,727	21,405	27,976	6,571	30.7%
Total, Idaho Operations Office	42,337	52,717	38,205	-14,512	-27.5%
National Energy Technology Laboratory (NETL)					
West Virginia	28,260	26,451	36,837	10,386	39.3%
University Programs (WV)	15,356	14,000	10,100	-3,900	-27.9%
Western Environmental Technology Office	13,000	10,504	6,514	-3,990	-38.0%
Total, National Energy Technology Laboratory (NETL)	56,616	50,955	53,451	2,496	4.9%
Nevada Operations Office					
Nevada Operations Office (NV)	3,094	2,225	2,305	80	3.6%
Oak Ridge Operations Office					
Oak Ridge Operations Office (TN)	27,313	20,508	16,146	-4,362	-21.3%

(dollars in thousands)

	FY 1999	FY 2000	FY 2001	$ Change	% Change
Oakland Operations Office					
Lawrence Berkeley National Laboratory (CA)	3,528	1,736	4,236	2,500	144.0%
Lawrence Livermore National Laboratory (CA)	3,347	1,189	683	-506	-42.6%
Oakland Operations Office (CA)	1,697	2,441	290	-2,151	-88.1%
Total, Oakland Operations Office	8,572	5,366	5,209	-157	-2.9%
Ohio Operations Office					
Fernald Environmental Management Project (OH)	1,570	4,505	279	-4,226	-93.8%
Mound (OH)	2,885	2,030	1,000	-1,030	-50.7%
West Valley (OH)	500	1,000	0	-1,000	-100.0%
Ohio Operations Office (OH)	195	765	995	230	30.1%
Total, Ohio Operations Office	5,150	8,300	2,274	-6,026	-72.6%
Richland Operations Office					
Pacific Northwest National Laboratory (WA)	17,810	14,877	12,227	-2,650	-17.8%
Richland Operations Office (WA)	7,920	5,471	13,975	8,504	155.4%
Total, Richland Operations Office	25,730	20,348	26,202	5,854	28.8%
Rocky Flats Office					
Kaiser Hill (CO)	3,825	8,471	3,650	-4,821	-56.9%
Savannah River Operations Office					
Savannah River Site (SC)	13,493	16,460	13,999	-2,461	-15.0%
Savannah River Operations Office (SC)	3,299	2,791	6,212	3,421	122.6%
Total, Savannah River Operations Office	16,792	19,251	20,211	960	5.0%
Headquarters					
Washington, D.C.	11,038	11,835	6,525	-5,310	-44.9%
Subtotal, Science and Technology	236,715	228,131	196,548	-31,583	-13.8%
FFTF Reprogramming Sources	0	1,282	0	-1,282	-100.0%
Total, Science and Technology	236,715	229,413 [a]	196,548 [a]	-32,865	-14.3%

[a] Final distribution of funds by site in FY 2000 and FY 2001 could change based upon changing priorities, and final receipt, review, selection and award of technical proposals.

Mixed Waste, Characterization, Treatment and Disposal Focus Area

Mission Supporting Goals and Objectives

Program Mission

The mission of the Mixed Waste Characterization, Treatment and Disposal Focus Area is to invest in cutting-edge technical and engineering solutions from initial need identification through technology deployment. Partnered with other Environmental Management programs, advanced solutions are accomplished via an end-user driven process. This process is aimed at efforts relating to mixed low-level waste and transuranic waste disposition needs as identified in the EM sites' baseline planning data.

Program Goal

The goal of the Mixed Waste Characterization, Treatment and Disposal Focus Area is to provide technical and engineering solutions to support effective, efficient mixed waste treatment technology systems. Site Treatment Plans identified 165,000 m^3 of mixed waste in storage that includes over 1,437 mixed waste streams at 40 sites. In addition, an estimated 181,000 m^3 of mixed low-level waste and transuranic waste will be generated over the next five years.

Program Objectives

The objective of the Mixed Waste Characterization, Treatment and Disposal Focus Area is to develop technologies that address the mixed low-level and mixed transuranic waste needs identified by the Site Technology Coordination Groups and that have been incorporated in the sites' baseline planning strategy. Having developed and assessed several primary mixed waste treatment systems, the current Mixed Waste Characterization, Treatment and Disposal Focus Area strategy emphasizes development and deployment of enabling technologies to assist the Department in meeting its mixed waste schedule commitments to regulators and the public at 36 sites in 19 states. With the funding provided, this Focus Area will assist in the deployment of alternative technologies at individual sites and implement and maintain sound program management and integration processes.

Performance Measures

The Science and Technology FY 2001 corporate performance metrics (25 technologies or technology systems demonstrated; 32 technologies or technology systems made ready for implementation; 60 alternative technologies deployed) are set at the Project Baseline Summary level, based on past program performance and the budget requested. The complete listing of specific technologies, by Focus Area, that will be demonstrated, made ready for implementation or deployed, is made available after the final FY 2001 project level funding is known and FY 2001 current year work plans are finalized by each Focus Area. FY 2001 current year work plans are schedule to be finalized by September 30, 2000.

Significant Accomplishments and Program Shifts

- Completed in FY 1999, development and demonstration of technologies to address alternatives to open flame combustion high temperature treatment (i.e., incineration). These technologies support facility compliance at six sites addressing approximately 5,400 cubic meters of mixed low-level and mixed transuranic waste.
- Complete in FY 2000, demonstration of HANDSS-55 modules. Subsequently, make the modules available for deployment at Savannah River Site, and a drum opening module available for Mound, Battelle Columbus, and Los Alamos National Laboratory.
- Complete in FY 2000, hydrogen getters and remote handled transuranic waste gas generation rate solution/matrix depletion demonstrations to support the Idaho National Engineering and Environmental Laboratory, the Los Alamos National Laboratory and the Savannah River Site in meeting the Waste Isolation Pilot Plant transportation requirements.
- Complete in FY 2000, phosphate-based demonstration at Hanford's Effluent Treatment Facility to provide a deployable low temperature stabilization process for the site's Effluent Treatment Facility residues.
- Complete in FY 2000, the National Initiative supporting Oak Ridge's Balance of Inventory process to enable the treatment of elemental mercury wastes from across the DOE complex.
- Complete in FY 2000, demonstration of commercially available particulate matter monitors at Oak Ridge Toxic Substance Control Act Incinerator. This will support the Toxic Substance Control Act Incinerator, the Consolidated Incineration Facility, the Waste Experimental Reduction Facility, and the Idaho Nuclear Technology and Engineering Center, decisions on applicability of mercury continuous emission monitoring needed for compliance with the Environmental Protection Agency Maximum Achievable Control Technology rule.
- Complete in FY 2001, Multi-Detector Analysis System demonstration on Idaho National Engineering and Environmental Laboratory remote handled transuranic surrogate waste to support Hanford, the Idaho

National Engineering and Environmental Laboratory, the Los Alamos National Laboratory and Oak Ridge in meeting remote handled transuranic shipping schedules defined in Site Treatment Plans.

- Complete in FY 2001, HANDSS-55 repackaging system. Automated Drum and Liner Opener, Waste Sorting, Waste Repackaging, Waste Reduction, and System Integration and Control Modules will commence deployment at the Savannah River Site.
- Complete demonstration in FY 2000, of the Transuranic Optimized Measurement System. Deployment at Savannah River in FY 2001 will allow the site to assay and segregate non-transuranic and transuranic waste.
- Complete in FY 2001, deployment of a technology that reduces the number of confinement layers in transuranic waste drums. This technology solution, made available to the Idaho National Engineering and Environmental Laboratory, will allow the site to meet the 3,100 m^3 commitment in the Idaho Settlement Agreement.
- In FY 2001, increased emphasis will be placed on basic science and applied research to address mid- to long-term mixed waste and transuranic needs.
- Thermal treatment activities will be re-initiated in FY 2000 and continued in FY 2001 at the request of the Mixed Waste Focus Area End-User Steering Committee and other end users. Funding for these activities was not originally requested due to budget constraints.
- Beginning in FY 2001, University Program and Western Environmental Technology Office activities will no longer be separate line items in the Office of Science and Technology budget. Consistent with the Focus Area centered approach, these activities have been included within each Focus Area's budget request.

Funding Schedule

	FY 2000 Current Appropriation	FY 2000 Current Appropriation	FY 2001 Request
Material Handling and Characterization Solutions	12,132	11,783	14,028
Non-Thermal Treatment Solutions	7,013	7,881	9,406
Thermal Treatment Enabling Solutions	8,942	7,766	4,568
Total, Mixed Waste, Characterization, Treatment and Disposal Focus Area	28,087	27,430	28,002

Detailed Program Justification

(dollars in thousands)

FY 1999	FY 2000	FY 2001

Material Handling and Characterization Solutions

Characterization development activities will focus on supporting the development and deployment of solutions that can improve the end-user's capacity to non-destructively examine and assay containerized waste, allowing workers to identify and quantify radioactive and hazardous components. Current characterization development activities focus on deployment of improved methods for characterizing radionuclides in low activity, contact-handled waste drums. Further development is needed regarding enabling technologies to characterize radionuclides in contact-handled boxes and remote-handled wastes.

(dollars in thousands)

FY 1999	FY 2000	FY 2001

Technology solutions to address boxes will use basic techniques developed for 55-gallon drums. Application of such techniques to larger box size waste containers is not easily accomplished using a simple scaling technique, and presents additional complications to established methods. Techniques need to be developed to account for waste-form-dependent radiation transport. Inconsistencies induced by the waste-form attributes of these large volume configurations are inevitable. There is a critical need for non-destructive analysis technology for remote-handled waste types. Development, demonstration and deployment of non-destructive analysis techniques to reduce pre-characterization costs and optimize mixed waste treatment operations (for example, the incinerators operated by DOE) are planned.

Transportation related activities focus on increasing the payload efficiency of transuranic waste shipments by addressing hydrogen gas generation and buildup issues. Hydrogen gas generation is caused by the radiolysis of hydrogenous waste packaging and materials. The Nuclear Regulatory Commission is concerned with the potential for fire or explosion during transport periods and therefore places restrictions on the contact-handled and remote-handled transuranic wastes that can be shipped using the TRUPACT-II and 72B casks.

(dollars in thousands)

	FY 1999	FY 2000	FY 2001
Material handling activities focus on improving the end-users capability to remotely handle highly radioactive waste streams during sizing, repackaging and transport operations. Due to the hazards associated with these wastes, advanced remote handling systems are needed to improve safety and efficiency of operations. A transuranic waste repackaging system will be developed and deployed at the Savannah River Site. This system remotely opens 55-gallon drums, removes non-compliant items and repackages the waste for transfer to the Waste Isolation Pilot Plant. This technology is being fully automated and adapted to a mobile platform to solve the remote-handled repackaging needs of many DOE sites. Several sites have large volumes of waste that must be size-reduced before disposal. The Mixed Waste Focus Area is developing remotely operable systems to size-reduce and segregate transuranic waste from low-level waste to better utilize existing disposal areas. In FY 2001, there are three work elements which support the Materials Handling and Characterization Solutions Product Line: 1.) Non-Destructive Characterization for Treatment, Transportation and Disposal of Mixed Low-Level Waste and Mixed-Transuranic; 2.) Payload Enhancement for Transporting transuranic Waste Within Regulatory Limits; and 3.) Handling Mixed Waste Contaminants Materials During Characterization, Treatment, Packaging and Disposal. # Demonstrate Multi-Detector Analysis System on remote handled transuranic surrogate waste at the Idaho National Engineering and Environmental Laboratory. # Deploy Transuranic Optimized Measurement System at the Savannah River Site. # Demonstrate HANDSS-55 Repackaging System at the Savannah River Site. # Demonstrate technology to reduce confinement layers within transuranic waste drums. # Complete remote handled transuranic gas generation studies.			
Material Handling and Characterization Solutions	12,132	11,783	14,028

(dollars in thousands)

FY 1999	FY 2000	FY 2001

Non-Thermal Treatment Solutions

The Department's mixed waste inventory contains hazardous organic materials that are difficult to stabilize. Therefore, oxidation of organic material prior to final treatment is advantageous. The presence of certain volatile substances (e.g. mercury, actinides, tritium) in the waste eliminates incineration as an oxidation method. Incinerators are also becoming more complex and expensive to permit and operate due to new emission regulations and stakeholder concerns. In addition, the three mixed waste incinerators in the complex (waste Experimental Reduction Facility, Consolidated Incineration Facility, and Toxic Substance Control Act) are not accessible to all DOE sites. These combined technical and policy considerations drive needs for alternative lower-temperature methods to oxidize organic materials. Transuranic mixed wastes containing organics also require alternative oxidation technologies. Potentially explosive hydrogen is generated in transuranic waste drums from the radiolysis of hydrogenous organics present in the waste oxidation prior to Waste Isolation Pilot Plant shipments is desirable to enable shipment without dramatically increasing the number of containers to be shipped, however, incineration is usually not an option because transuranic material is often very respirable.

(dollars in thousands)

FY 1999	FY 2000	FY 2001

Mercury is present in a broad range of concentrations in several of the DOE's mixed waste streams. Because it is highly mobile and easily vaporized, the presence of mercury complicates designing off-gas systems, stabilizing treatment residues, and monitoring all effluents. Removing mercury before treatment would significantly simplify downstream treatment operations, thereby reducing the cost of treatment facility design, construction, and operation risks. The separated mercury must then be amalgamated, or otherwise stabilized for disposal as a separate waste stream. The Environmental Protection Agency specifies different treatments for mercury-contaminated wastes depending on the concentration of mercury in the waste matrix. Currently, there are no processes applicable to large scale radioactive environments which will produce a waste form which complies with stringent Environmental Protection Agency disposal requirements.

Portland cement is the baseline low-temperature stabilization technology currently used for much of the sludge, soils, and homogeneous solids that comprise the Department’s mixed-low- level waste inventory. Unfortunately, cement has proven an inefficient method for many of these waste streams. In particular, the waste streams produced as fly ash or scrubber blowdown from the Department’s incinerators present unique problems because they contain salts, excessive heavy metals, unburned organics, and other nuisance substances. These materials, in sufficient quantities, can cause premature degradation of the waste form or prevent concrete waste-forms from setting. This problem is currently rectified by mixing very low proportions of the waste material with the Portland cement. This practice significantly increases waste volume, which increases waste handling and transportation costs and consumes scarce disposal capacity. Alternative stabilization technologies, capable of maintaining waste-form integrity at higher waste loadings, are needed. Based on a survey of site needs, technologies are also required for the micro- and macro-encapsulation of various mixed wastes in general.

(dollars in thousands)

	FY 1999	FY 2000	FY 2001
In FY 2001, two work elements support this product line: 1) Alternatives to Incineration to Reduce Emissions Hazards; 2) Facilitating Deployment for Unique Waste.			
# Complete development and selection of alternative oxidation technologies selected for treatment demonstration on the Savannah River Site Pu-238 Job Control Waste.			
# Demonstration of Delphi DETOX.			
# Deploy Self Assembled Mesoporous Mercapton for removing mercury from identified waste streams.			
# Deploy solutions for three unique waste streams selected during FY 2000.			
Non-Thermal Treatment Solutions	7,013	7,881	9,406

Thermal Treatment Enabling Solutions

DOE operates thermal treatment systems for a variety of mixed, low, and high-level wastes. Each of these facilities is part of one or more compliance agreements between DOE sites and their respective states. Treatment facilities operate under increasingly stringent regulatory permits, threatening future operation of many of these facilities. Additional issues arise involving public stakeholders concerned whether or not DOE's treatment facilities are emitting hazardous pollutants.

(dollars in thousands)

FY 1999	FY 2000	FY 2001

Currently, the most pressing concerns within DOE's thermal treatment systems are a direct result of the proposed Environmental Protection Agency rule for Maximum Achievable Control Technology for Hazardous Waste Combustors (MACT Rule), which was promulgated in July, 1999. Each of the three DOE incinerators and the Idaho Nuclear Technology and Engineering Center calciner have demonstrated in test burns that they may not be able to meet at least one provision of the Maximum Achievable Control Technology Rule. Unfortunately, the diagnostic tools needed to verify whether emissions can meet the Maximum Achievable Control Technology Rule often do not exist, therefore, facility operators must resort to periodic and costly sampling and analysis. Continuous emissions monitors capable of accurately monitoring emissions would be a significant advancement.

Under the Maximum Achievable Control Technology Rule, compliance must be achieved within three years from the date of promulgation. This rule will directly impact the three DOE incinerators and the Idaho Nuclear Technology and Engineering Center high-level waste calciner. Each facility must submit a Notice of Intent to Comply, which will indicate how they will meet the emission limits contained in the Maximum Achievable Control Technology Rule. Therefore, sites must have a viable option for meeting emission limits by September 2000, and be able to install any needed equipment by September 2002. This means that solutions should be identified within the next one and a half to two years.

In FY 2001, one work element supports this product line: Monitoring and Removing Hazardous and Radioactive Contaminants from Offgas Streams.

- # Demonstrate resonance enhanced multiphoton ionization dioxin/furan monitor.
- # Deploy Pre-High-Efficiency Particulate Air Particulate Matter Filter at Savannah River CIF.
- # Evaluate two continuous emission monitors.

	(dollars in thousands)		
	FY 1999	FY 2000	FY 2001
# Demonstrate mercury continuous emission monitors at the Oak Ridge Toxic Substance Control Act Incinerator.			
# Complete technical development and demonstration activities at the Western Environmental Technology Office.			
Thermal Treatment Enabling Solutions	8,942	7,766	4,568
Total, Mixed Waste, Characterization, Treatment and Disposal Focus Area	28,087	27,430	28,002

Explanation of Funding Changes from FY 2000 to FY 2001

	FY 2001 vs. FY 2000 ($000)
Material Handling and Characterization Solutions	
# Increase supports technology development activities related to advanced remote handling systems	2,245
Non-Thermal Treatment Solutions	
# Increase supports efforts to develop, demonstrate and deploy technologies, primarily Alternative Oxidation Technologies, which offer non-flame alternatives to incineration of organics in waste; and technologies that address unique waste streams	1,525
Thermal Treatment Enabling Solutions	
# Decrease reflects completion in FY 2000 of demonstrations related to particulate matter monitors at Oak Ridge.	-3,198
Total Funding Change, Mixed Waste, Characterization, Treatment and Disposal Focus Area	572

Radioactive Tank Waste Remediation Focus Area

Mission Supporting Goals, and Objectives

Program Mission

The mission of the Radioactive Tank Waste Remediation Focus Area is to deliver integrated technical solutions that enable tank waste remediation to be successful across the DOE complex. To do this, the Radioactive Tank Waste Remediation Focus Area:

- Brings together users and technical experts to define and execute the mission.
- Integrates the work across the DOE complex and other funding organizations.
- Builds teams of users and providers to deliver and deploy technical solutions.

Program Goal

There are over 280 large radioactive waste storage tanks and other miscellaneous underground storage tanks across the DOE complex containing over 90 million gallons of radioactive waste. Most of these tanks have exceeded their design life and represent significant occupational and public risks. Current site baseline technologies are costly, pose significant programmatic and safety risks, and have technology gaps. Using an integrated approach, the goal of the Radioactive Tank Waste Remediation Focus Area is to systematically manage the development and facilitate the deployment of technical solutions to safely and efficiently achieve tank waste remediation across the DOE complex. Accomplishment of this goal will support closure of tank farms complex-wide while minimizing life-cycle costs.

Program Objectives

The objective of this Focus Area is to address the technical needs identified for management of high-level waste and closure of tanks by the Site Technology Coordination Groups. These needs have been incorporated in the EM sites' baseline planning strategy. Tank Waste Remediation Focus Area activities have progressed from early-stage technology development to advanced, fully deployable systems. This work is being accomplished in close partnership with users and with the continual participation of tribal governments, regulators, and stakeholders. Within the funding provided, this Focus Area will assist in the deployment of alternative technologies at individual sites and implement and maintain sound program management and integration processes.

Performance Measures

The Science and Technology FY 2001 corporate performance metrics (25 technologies or technology systems demonstrated; 32 technologies or technology systems made ready for implementation; 60 alternative technologies deployed) are set at the Project Baseline Summary level, based on past program performance and the budget requested. The complete listing of specific technologies, by Focus Area, that will be demonstrated, made ready for implementation or deployed, is made available after the final FY 2001 project funding level is known and FY 2001 current year work plans are finalized by each Focus Area. FY 2001 current year work plans are scheduled to be finalized by September 30, 2000.

Significant Accomplishments and Program Shifts

- Deploy in FY 2000, retrieval technologies for heel removal from Savannah River Tank 19 to ready tank for closure.
- Deliver in FY 1999 a solid-liquid separation system to Oak Ridge to pretreat tank wastes.
- Deploy in FY 2001, grouting technology to treat INEEL newly generated wastes to meet compliance agreements.
- Deploy in FY 2000, technologies to reduce the size of high-level waste contaminated equipment at West Valley to enable equipment decontamination and disposal as low-level waste.
- Demonstrate and deploy in FY 2000 and FY 2001, grout injection and mixing technology to enable tank closure of small radioactive waste tanks at Savannah River and Oak Ridge.
- Demonstrate and deploy in FY 2000 and FY 2001, tank waste retrieval technologies enabling continued processing plant feed delivery and tank closure activities at Savannah River Site, West Valley Demonstration Project, Oak Ridge Reservation, and Hanford Site.
- Deploy in FY 2001, regenerable High-Efficiency Particulate Air Filter technology at Savannah River Site.
- Demonstrate in FY 2001, systems supporting Idaho National Engineering and Environmental Laboratory Title I Design, including an integrated cesium, strontium, and transuranic solvent extraction process, low-activity waste conditioning and immobilization, and a baseline integrated flowsheet.
- Demonstrate in FY 2000 and FY 2001, alternative salt cesium removal processes for Savannah River Site to support final design of the replacement for In-Tank Precipitation.

- Demonstrate in FY 2000 and FY 2001, chemical and mechanical methods for pipeline unplugging to reduce risks of waste retrieval and transfer at the Savannah River Site, Hanford Site, and Oak Ridge Reservation.
- Deploy in FY 2000, waste tank corrosion probe systems at Hanford site and Savannah River site, and an integrated monitoring station at Hanford site.
- Demonstrate and recommend in FY 2001, designs for the next generation melter for Savannah River Site and the high-level waste melter for Idaho National Engineering and Environmental Laboratory to reduce costs of processing and enable system design.
- In FY 2001, increased emphasis will be placed on basic science and applied research to address mid to long-term high-level waste tank needs.
- Beginning in FY 2001, University Program activities will no longer be a separate line item in the Office of Science and Technology budget. Consistent with the Focus Area centered approach, these activities have been included within each Focus Area's budget.

Funding Schedule

	FY 1999 Current Appropriation	FY 2000 Current Appropriation	FY 2001 Request
Tank Waste Retrieval and Closure	21,829	19,226	30,106
Tank Waste Pretreatment and Immobilization	23,444	25,776	26,830
Total, Radioactive Tank Waste Remediation Focus Area	45,273	45,002	56,936

Detailed Program Justification

(dollars in thousands)

FY 1999	FY 2000	FY 2001

Tank Waste Retrieval and Closure

(dollars in thousands)

FY 1999	FY 2000	FY 2001

The Savannah River Site, Hanford Site, Idaho National Engineering and Environmental Laboratory (Idaho), Oak Ridge Reservation, and West Valley Demonstration Project require technical assistance, technology development, and baseline technology performance verification to improve efficiency, reduce costs and risks, and enable baseline tank waste retrieval and closure systems to be implemented. Each of these sites is at a different stage in the retrieval of wastes and closure of tanks. Oak Ridge and West Valley have retrieved the majority of the bulk wastes and are focused on residuals removal and tank closure. Savannah River is continuing sludge and heel retrieval to feed the Defense Waste Processing Facility and to continue tank closures. Hanford is preparing for waste retrieval to support Phase I privatization feed delivery, while Idaho is focused on an accelerated schedule for tank closure.

(dollars in thousands)

FY 1999	FY 2000	FY 2001

Within the Tank Waste Retrieval and Closure Product Line, more cost effective and efficient methods to mobilize and retrieve sludges and ensure continued feed delivery will be deployed. Pipeline unblocking tools will be demonstrated to reduce the risks of blocked waste transfer lines and interruptions in feed delivery. Improved sampling and analysis systems for retrieved wastes will be developed. Heel retrieval and tank cleaning systems will be developed and deployed to enable tank closure. In-tank stabilization systems will be developed and deployed for closure of small, limited access tanks. Tank farm operational improvements, including tank ventilation, tank integrity inspection, pump pit maintenance, and tank corrosion monitoring systems, will be deployed to reduce costs and risks of tank farm operations that support the retrieval and safe waste storage operations. To reduce the risks of future leaks to the vadose zone and to enable retrieval from single-shell tanks, leak monitoring and mitigation systems will be developed. Future processing will require retrieval of currently stored calcine wastes at Idaho. Methods for dry retrieval of calcine will be identified and tested to establish a baseline for process design decisions. Activities will continue to deploy mixing, mobilization, heel retrieval, cleaning, waste conditioning, and monitoring technology to accomplish retrieval and consolidation efforts at Oak Ridge Reservation's Melton Valley facility. Retrieval systems will be developed and deployed for small horizontal tanks, and stabilization methods will be deployed for grouting and closure of tanks. Heel retrieval and systems will be deployed at West Valley to support decisions on a final tank closure strategy and meet compliance schedules.

In FY 2001, there are five work elements that support this product line: 1) Transfer Line Unplugging/Feed Analysis; 2) Waste Mobilization and Retrieval; 3) Tank Integrity and Heel Retrieval; 4) Ancillary Tank Equipment Enhancements; and 5) Tank Closure.

- Demonstrate chemical and mechanical methods for pipeline unplugging to reduce risks of waste retrieval and transfer at the Savannah River Site, Hanford, and Oak Ridge Reservation.
- Fabricate and deliver a multi-depth sampler system to Hanford to support feed delivery for private vendor treatment.

(dollars in thousands)

	FY 1999	FY 2000	FY 2001
# Deploy waste retrieval technologies at the Savannah River Site for large high-level waste tanks and small radioactive waste tanks to enable continued Defense Waste Processing Facility plant feed delivery and tank closure activities.			
# Demonstrate commercial systems for improved sludge retrieval at Hanford to meet private vendor feed delivery requirements.			
# Deploy advanced chemical cleaning and heel retrieval technologies at Savannah River Site and West Valley to support tank closure preparations.			
# Deploy remote tank inspection technologies at Idaho to ensure safe waste storage.			
# Deploy waste tank corrosion probe systems at Oak Ridge Reservation and Hanford to ensure safe waste storage conditions while private vendor treatment proceeds.			
# Deploy regenerable High-Efficiency Particulate Air Filter technology at Savannah River Site to reduce costs and risks of current tank ventilation filter system.			
# Deploy tank pump pit remote technology to reduce worker risks and costs of waste retrieval, transfer, and feed staging operations at Hanford.			
# Deploy grout injection technology at Oak Ridge Reservation to mix and stabilize tank residuals for closure.			
Tank Waste Retrieval and Closure	21,829	19,226	30,106

(dollars in thousands)

FY 1999	FY 2000	FY 2001

Tank Waste Pretreatment and Immobilization

The Savannah River Site, Hanford Site, Idaho National Engineering and Environmental Laboratory (Idaho), Oak Ridge Reservation, and the West Valley Demonstration Project require technical assistance, technology development, and baseline process performance verification to improve process efficiency, reduce costs and risks, meet regulatory schedules, and enable baseline tank waste processing systems to be implemented. Savannah River must maintain the Defense Waste Processing Facility operations and improve throughput to meet cannister production requirements; Hanford must prepare for and deliver feed for privatization Phase I and support privatization Phase II procurement; Idaho must continue baseline flowsheet development and testing to meet Title I design schedule. Finally, sludge transfer at Oak Ridge Melton Valley Storage Tanks must be accomplished to meet privatization schedules. Each of these sites is at a different stage in the processing of radioactive tank wastes.

(dollars in thousands)

FY 1999	FY 2000	FY 2001

Within the Tank Waste Pretreatment and Immobilization Product Line activities will address Defense Waste Processing Facility melter improvements including pour spout design changes, improved waste loading in glass, and next generation melter technology to increase throughput and melter life. Process additions and improvements in remote technology for maintenance and decontamination activities within the melter facility will also be addressed to improve process efficiencies and reduce costs. The baseline in-tank precipitation process for removal of cesium and other radionuclides from salt solutions prior to immobilization at Savannah River was discontinued in 1998 due to technical and safety problems. A salt disposition alternative is required to enable future processing and immobilization of the salt wastes. Downselection and pilot-scale demonstration of the preferred salt disposition alternative will be performed to meet baseline project design requirements and avoid the cost impacts of further delays to immobilization operations with salt feed. At Hanford, waste solution chemistry studies will be performed to identify operating envelopes for waste transfers that minimize the unwanted formation of solids that can increase risks to feed delivery. Product acceptance methods will be developed to reduce the risks of receiving out-of-specification waste products that cannot be disposed. At Idaho, testing of flowsheet unit operations, downselection to preferred options, and integrated design and testing of the pretreatment and immobilization processes is required to support the design schedule. Activities will include integrated radionuclides solvent extraction testing, immobilized low- and high-activity waste formulation and conditioning development, and melter design for high-activity waste immobilization. In addition, Idaho must meet new consent order requirements for reduction of newly generated tank wastes. A mercury removal process for newly generated wastes will be tested and implemented. Ongoing deployment of advanced systems for managing tank contents will be completed at Oak Ridge. Remote and process technology will be developed and deployed at West Valley to enable decontamination and disposal of process equipment. A canister decontamination system will be implemented to enable offsite transportation.

(dollars in thousands)

	FY 1999	FY 2000	FY 2001
In FY 2001, there are four work elements that support this product line: 1) Enhanced Immobilization Productivity; 2) Product Acceptance and Canister Storage; 3) Solids Pretreatment; and 4) Radionuclide Removal.			
# Demonstrate and recommend designs of a next generation melter for Savannah River Site and the high-level waste melter for the Idaho National Engineering and Environmental Laboratory to reduce costs of processing and enable system design.			
# Demonstrate and recommend a baseline integrated flowsheet for the Idaho National Engineering and Environmental Laboratory high-level waste system to enable process downselection and Title 1 design to proceed.			
# Procure improved high-level waste canister decontamination system to improve processing throughput and reduce costs at the Savannah River Site and West Valley.			
# Demonstrate an alternative salt and cesium removal process for Savannah River Site to support final design of replacement for In-Tank Precipitation.			
# Demonstrate an integrated cesium, strontium, and transuranic solvent extraction process for the Idaho National Engineering and Environmental Laboratory to support Title I design.			
Tank Waste Pretreatment and Immobilization	23,444	25,776	26,830
Total, Radioactive Tank Waste Remediation Focus Area	45,273	45,002	56,936

Explanation of Funding Changes from FY 2000 to FY 2001

	FY 2001 vs FY 2000 ($000)
Tank Waste Retrieval and Closure	
# Increase focus on technology development activities to address tank pipeline blockage; tank stabilization ventilation, integrity, corrosion protection, and monitoring needs; and waste mixing, mobilization retrieval, cleaning, conditioning and monitoring requirements	10,880
Tank Waste Pretreatment and Immobilization	
# Increased efforts to demonstrate an alternative cesium removal process for salt disposition at Savannah River and procurement of a high-level waste cannister decontamination system . . .	1,054
Total Funding Change, Radioactive Tank Waste Remediation Focus Area	11,934

Subsurface Contaminants Focus Area

Mission Supporting Goals, and Objectives

Program Mission

The mission of the Subsurface Contaminants Focus Area is to provide innovative technology solutions and technical assistance. Partnered with other EM programs, the Subsurface Contaminants Focus Area offers technology and assistance to end users to achieve cleanup goals and fulfills its pledge to oversee long-term monitoring of soils and groundwater at DOE sites.

Program Goal

The Subsurface Contaminants Focus Area develops, demonstrates, and deploys innovative technology solutions to solve end user soil and groundwater problems. New technologies will provide improved characterization, monitoring, and containment solutions to the inherent risks associated with long-term isolation of buried waste, and in-situ remediation of dispersed contaminants. Successful innovative solutions will satisfy state and Federal regulatory compliance requirements and reduce health and safety risks.

Across the DOE complex, 5,700 plumes contaminate more than 75 million m^3 of soil and 475 billion gallons of groundwater with volatile organic compounds, Dense Non-Aqueous Phase Liquids, hazardous metals and radionuclides. Three million m^3 of solid radioactive and hazardous wastes buried in landfills, trenches, and spill areas continue to leach and feed these plumes. The contaminants pose significant health and safety risks and are present at all DOE sites, located at various depths in the vadose and saturated zones. In order to meet the EM sites' baseline planning goals and Federal and state compliance laws, cleanup must be accelerated and cleanup costs reduced. The Subsurface Contaminants Focus Area is coordinating vadose zone research efforts with all DOE operations offices, especially Richland in their efforts for remediation of contaminants under the high-level waste tanks.

Program Objectives

The objective of this Focus Area is to develop technologies that address environmental restoration problem area needs identified by the Site Technology Coordination Groups. These needs are included in the EM sites' baseline planning strategy. Implementation of this program in an integrated manner with other Federal agencies, industry, national labs, and universities will result in faster cleanup and lower cost to the taxpayer. With the funding provided, this Focus Area will assist in the deployment of alternative technologies at individual sites and implement and maintain sound program management and integration processes.

Performance Measures

The Science and Technology FY 2001 corporate performance metrics (25 technologies or technology systems demonstrated; 32 technologies or technology systems made ready for implementation; 60 alternative technologies deployed) are set at the Project Baseline Summary level, based on past program performance and the budget requested. The complete listing of specific technologies, by Focus Area, that will be demonstrated, made ready for implementation or deployed, is made available after the final FY 2001 project level funding is known and FY 2001 current year work plans are finalized by each Focus Area. FY 2001 current year work plans are scheduled to be finalized by September 30, 2000.

Significant Accomplishments and Program Shifts

- Complete in FY 2000, Phase II multi-Federal agency demonstration for the removal of Dense Non-Aqueous Phase Liquids contamination from soil at Cape Canaveral using heating technologies and oxidative destruction.
- Continue in FY 2001, multi-year tasks performed in cooperation with the Environmental Protection Agency to improve landfill caps, covers and barriers to prevent the migration of wastes from DOE sites. The Environmental Protection Agency is incorporating the data from these successful demonstrations into national landfill cover design guidance.
- Demonstrate in FY 2001, Dense Non-Aqueous Phase Liquid detection at depth and/or difficult settings to support remediation at Hanford and Oak Ridge.
- Complete in FY 2001, in-situ vitrification at Los Alamos National laboratory.
- Develop in FY 2001, standard methods to use gas tracers to detect underground leaking utilities at multiple sites.
- Demonstrate in FY 2001, in-situ remediation of mercury at Oak Ridge.
- Deploy in FY 2001, surfactant-enhanced aquifer remediation at neutral buoyancy at Melford, New Hampshire.
- Demonstrate in FY 2001, in-situ systems for long-term monitoring of containment systems at Sandia National Laboratory Mixed Waste Landfill.
- Demonstrate in FY 2001, a Dense Non-Aqueous Phase Liquid source zone delineation technology.
- In FY 2001, increase emphasis on basic science and applied research to address mid to long-term soil and groundwater needs.

Beginning in FY 2001, University Program and Western Environmental Technology Office activities will no longer be a separate line in the Office of Science and Technology budget. Consistent with the Focus Area centered approach, these activities have been included within each Focus Area's budget.

Funding Schedule

	FY 1999 Current Appropriation	FY 2000 Current Appropriation	FY 2001 Request
Dense Non-Aqueous Phase Liquids	18,168	15,420	12,357
Source Term Containment/Source Term Remediation	10,670	11,370	12,087
Metals and Radionuclides in the Vadose and Saturated Zones	11,344	14,520	12,759
Total, Subsurface Contaminants Focus Area	40,182	41,310	37,203

Detailed Program Justification

(dollars in thousands)

FY 1999	FY 2000	FY 2001

Dense Non-Aqueous Phase Liquids (Delineation, Removal or In-situ Treatment)

All major DOE sites have difficulty remediating groundwater contamination resulting from the discharge into the soil of toxic and carcinogenic organic solvents termed Dense Non-Aqueous Phase Liquids. Dense Non-Aqueous Phase Liquids are difficult to locate, and even in small quantities, create large contaminated groundwater plumes. The dense nature and low solubility of these compounds allows them to move downward through the vadose zone and groundwater and to spread laterally along low permeability layers forming disseminated pools, which slowly contaminate groundwater. No technology exists to cost effectively locate Dense Non-Aqueous Phase Liquids sources. Therefore, pump-and-treat, or other costly, ineffective and time consuming treatment systems must be used to maintain compliance for many cleanup projects. In some hydrogeologic settings, it is not practical to install pumping systems. Focus will be on the development of technologies and methods to locate and quantify Dense Non-Aqueous Phase Liquids sources, treat the contaminated groundwater and soils in-situ to reduce cleanup mortgages while enabling cost-effective cleanup. Virtually every field office site across the complex has a need for improved analytical tools and in-situ monitoring devices that eliminate the need to retrieve and transport samples. Dense Non-Aqueous Phase Liquid activities, including innovative characterization technologies, reactive barrier technologies, bioremediation, and in-situ chemical destruction will be demonstrated in cooperation with other federal agencies and in international initiatives. Significant efforts by private industry and the DOE national laboratories will be aimed at contaminant characterization and delineation in the vadose zone and deep and complex geologic settings.

(dollars in thousands)

FY 1999	FY 2000	FY 2001

In FY 2001, there are six distinct work elements which support this Product Line: 1.) Characterization, Monitoring, Modeling and Analysis; 2.) In-situ Reactive Treatment Barriers; 3.) Bioreactive Treatment; 4.) Vadose Zone Chemical Treatment Targeted for Dense Non-Aqueous Phase Liquids; 5.) Saturated Zone Chemical Treatment Targeted for Dense Non-Aqueous Phase Liquids; 6.) Deep Subsurface Access and Delivery Methods for Dense Non-Aqueous Phase Liquids.

- # Demonstrate Dense Non-Aqueous Phase Liquids Source Zone Delineation Technology.
- # Develop Dense Non-Aqueous Phase Liquids detection techniques for deep and fractured geologic settings at Oak Ridge.
- # Continue development of vadose zone contaminant fate and transport models.
- # Deploy Laser Induced Fluorescence, Alcohol Microinjection/Extraction, and Hydrophobic Flexible Membrane at Savannah River.
- # Continue performance verification of Dense Non-Aqueous Phase Liquids Reactive Barrier System.
- # Deploy Bioremediation Treatment Technology System at Oakland.
- # Continue development of phytoremediation technologies with university and international partners.
- # Deploy hydro-fracturing technology to treat Dense Non-Aqueous Phase Liquids in clay at Portsmouth, Ohio.
- # Continue joint Environmental Protection Agency/Department of Defense/industry effort to demonstrate surfactant technology to enhance aquifer remediation.
- # Complete verification and documentation of in-situ destruction techniques for Dense Non-Aqueous Phase Liquids demonstration at Cape Canaveral under the consortium (DOE, Department of Defense, United States Air Force, Environmental Protection Agency) including final cost efficiencies.
- # Continue advanced bioremediation and enhanced natural attenuation research under international agreements.

	(dollars in thousands)		
	FY 1999	FY 2000	FY 2001
# Conduct applied scientific research into the fate, transport and treatment of contaminants in varying soil matrices and under differing environmental chemical conditions.			
# Deploy deep Dense Non-Aqueous Phase Liquids access and treatment delivery system at Oak Ridge.			
Dense Non-Aqueous Phase Liquid	18,168	15,420	12,357

Source Term Containment/Source Term Remediation

DOE continues to spend a large part of its resources on monitoring and maintaining leaking radioactive and mixed waste landfills to achieve compliance with regulatory requirements. In addition, DOE will be unable to remediate these landfills to meet regulatory standards. Landfill containment systems are currently being deployed across the DOE complex and nation. However, many of these cover systems which were built to current regulatory specifications are failing and will require costly repair or replacement. The development of improved verification and monitoring systems to evaluate both the construction and performance of barrier systems will improve barrier performance and reduce the life-cycle cost of containment. Currently, verification and monitoring systems exist only for newly constructed engineered landfills. Additionally, the emplacement of barriers at significant depths has not been accomplished. Current remediation actions do not utilize deep-placement technologies, and programs often opt to implement more costly solutions. The demonstration of deep-placement barriers will improve alternatives and reduce costs. However, source term retrieval of DOE mixed waste has not been done. Therefore, better caps, covers and barriers are needed to prevent the migration of the unique DOE disposed wastes.

A design manual for a risk-based design life is required. To that end, technologies are also needed to stabilize and/or retrieve hot spots with unusually high contamination levels so that they can be appropriately treated or disposed. These solutions will reduce the risk of contaminant migration in the environment, speed cleanup, and facilitate safer cleanup. All this serves to reduce risk to the public and site workers as well as reduce environmental degradation.

(dollars in thousands)

	FY 1999	FY 2000	FY 2001
In FY 2001, there are five distinct work elements which support this Product Line: 1.) Subsurface Barrier Systems in the Vadose Zone; 2.) Stabilization Technologies; 3.) Hot Spot Removal; 4.) Validation, Verification and Long-term Monitoring of Containment and Treatment; and 5.) Long-Lived Caps.			
# Demonstrate subsurface containment systems in support of the Hanford vadose zone integration and Columbia River protection efforts at depths greater than 100 feet.			
# Verify performance of in-situ vitrification system using innovative bottom up approach at actual waste sites at Los Alamos National Laboratory.			
# Deploy "Dig Face Characterization and Hot Spot Removal " technology to delineate soil contamination at the Oak Ridge.			
# Develop standard methods to use Soil Gas Tracers to detect underground utility leaks.			
# Continue developing long-term covers and long-term monitoring systems to develop performance specifications acceptable to regulatory agencies in multiple states. This will allow for multiple deployments.			
# Deploy Evapotranspiration Cover/Integrated Fiber-Optic Performance Monitoring System at Albuquerque.			
# Continue deployments of advanced landfill covers.			
# Evaluate plant root intrusion of alternative landfill cover designs.			
# Complete deployment and monitoring of phytoremediation stabilization of mixed waste plume at Argonne National Laboratory.			
# Continue evaluation of alternative cap and cover material and develop risk based cover design manual.			
# Continue development of robotic mechanisms for hot spot removal technologies and the remote retrieval of buried wastes.			
Source Term Containment/Source Term Remediation	10,670	11,370	12,087

(dollars in thousands)

FY 1999	FY 2000	FY 2001

Metals and Radionuclides in the Vadose and Saturated Zones

Metals and radionuclides contamination is present in the vadose and saturated zones at all DOE Operations Offices. Current technologies for the treatment of metals and radionuclides typically include excavation followed by ex-situ treatment or pump-and-treat. These methods are costly, ineffective, and involve risk to workers. In addition, they are inadequate to attain EM sites' baseline planning goals. Limited access to contaminants and low contaminant mobility at Albuquerque, Chicago, Oak Ridge, Rocky Flats, and Hanford require reactive barrier technologies that remove or destroy radionuclide and hazardous metal contaminants moving in groundwater. To effectively address the existing site needs, solutions also must be developed that reduce or eliminate the volume of secondary waste and minimize workers' exposure and reduce risk to the environment. Partnerships with industry, the Environmental Protection Agency, the Department of Defense and other Federal agencies will lead to the cost effective development of in-situ chemical treatment technologies that convert contaminants to less hazardous states and to the development of effective metal and radionuclide treatment/removal technologies. Improved drilling technology for sampling, delivery of treatment chemicals, or contaminant removal will be demonstrated. Existing access, sampling, and delivery methods cannot place characterization and treatment technologies in DOE's deep plumes. Deep plumes will be the most costly to remediate due to contaminant depth and geologic complexity. Improved technologies are needed to address these deep contaminants.

In FY 2001, there are seven distinct work elements which support this Product Line: 1.) Characterization, Monitoring, Modeling and Analysis; 2.) In-situ Reactive Treatment Barriers; 3.) Stabilization Technologies; 4.) Vadose Zone Treatment Systems; 5.) Saturated Zone Treatment Systems; 6.) Deep Access and Delivery Methods; and 7.) Validation, Verification and Long-term Monitoring of Containment and Treatment.

- # Develop in-situ minimally intrusive characterization and assessment techniques for metal and radionuclides.

(dollars in thousands)

	FY 1999	FY 2000	FY 2001
# Continue development of the Joint Coordinating Committee on Environmental Restoration and Waste Management vadose zone contaminant fate and transport models.			
# Develop and deploy injectable media for Reactive Barrier Systems.			
# Continue performance verification of Reactive Barrier Technology System at Oak Ridge and Rocky Flats.			
# Evaluate tritium control and monitoring technologies.			
# Develop Vadose Zone Test Facility at Hanford.			
# Deploy Groundwater Monitoring System at Brookhaven National Laboratory.			
# Continue development of and demonstrate improved in-situ soil flushing technology based on the EM Science Program metals/mineral binding.			
# Demonstrate in-situ remediation of mercury in soils at Oak Ridge.			
# Complete deployment of In-situ Gaseous Reduction of Metals in Soils technology at Hanford.			
# Demonstrate in-situ soil flushing technology for mobilization/extraction of radionuclides and hazardous metals.			
# Demonstrate remediation of radionuclides in the Vadose Zone at the Nevada Test Site and Hanford.			
# Demonstrate mixed metal/radionuclide treatment technology in complex hydro-geologic setting at Albuquerque.			
# Perform vadose zone chemical treatment in conjunction with Mississippi State University.			
# Conduct research into the treatment of contaminants in the vadose zone.			
Metals and Radionuclides in the Vadose and Saturated Zones	11,344	14,520	12,759
Total, Subsurface Contaminants Focus Area	40,182	41,310	37,203

Explanation of Changes from FY 2000 to FY 2001

	FY 2001 vs FY 2000 ($000)
Dense Non-Aqueous Phase Liquids (Delineation, Removal or In Sit Treatment)	
# Decrease primarily due to completion in FY 2000, of Accelerated Site Technology Deployment projects	-3,063
Source Term Containment/Source Term Remediation	
# Increase primarily due to increased focus on applied research activities addressing stabilization and barrier technology needs	717
Metals and Radionuclides in the Vadose and Saturated Zones	
# Decrease primarily related to completion in FY 2000, of Accelerated Site Technology Deployment projects and completion of reactive barrier technology development activities; offset by an increase for technology development activities addressing vadose and saturated zone technology needs	-1,761
Total Funding Change, Subsurface Contaminants Focus Area	-4,107

Deactivation and Decommissioning Focus Area

Mission Supporting Goals, and Objectives

Program Mission

The mission of the Deactivation and Decommissioning Focus Area is to identify, develop, demonstrate, and assist the deployment of improved deactivation and decommissioning technology systems which not only reduce costs, but also health and safety risks to workers, the public and the environment. The Focus Area addresses immediate and long-term needs of radiologically-contaminated surplus facilities within the DOE complex to accelerate decontamination and decommissioning schedules.

Program Goal

The goal of the Deactivation and Decommissioning Focus Area is to efficiently and cost effectively develop, demonstrate and facilitate the implementation of safe/low risk systems to resolve problems and manage needs identified by the EM programs to successfully deactivate and decommission DOE's radioactively contaminated surplus facilities. The primary goal of the Focus Area is to reduce the estimated $12 billion deactivation and decommissioning mortgage as reported in the EM sites' baseline planning data by 50 percent. Two-thirds of the estimated $12 billion in deactivation and decommissioning work is scheduled for post-2006. The Focus Area's goal is to reduce the pre-2006 mortgage of approximately $4 billion by $1 billion and the post-2006 mortgage (nearly $8 billion) by $5 billion. Within the funding provided, this Focus Area will assist in the development of alternative technologies at individual sites and implement and maintain sound program management and integration processes to achieve the cost savings and risk reduction goals.

Program Objectives

The Deactivation and Decommissioning Focus Area's objective is to rapidly demonstrate and validate innovative and improved deactivation and decommissioning technologies via Large-Scale Demonstration and Deployment Projects (LSDDP). This approach focuses on developing specific, high priority deactivation and decommissioning projects identified by and co-funded with facility owners. The Large-Scale Demonstration and Deployment Projects demonstrate full-scale innovative and improved deactivation and decommissioning technologies, beside existing baseline technologies. The purpose is to compare benefits from using a suite of innovative deactivation and decommissioning technologies against those associated with baseline technologies. Primary drivers of this work are reduced costs/mortgages, a significant reduction in risk to workers involved in

waste cleanup efforts, and the recycle (where feasible) or reduction of large amounts of waste generated from deactivation and decommissioning activities.

Performance Measures

The Science and Technology FY 2001 corporate performance metrics (25 technologies or technology systems demonstrated; 32 technologies or technology systems made ready for implementation; 60 alternative technologies deployed) are set at the Project Baseline Summary level, based on past program performance and the budget requested. The complete listing of specific technologies, by focus area, that will be demonstrated, made ready for implementation or deployed, is made available after the final FY 2001 project level funding is known and FY 2001 current year work plans are finalized by each Focus Area. FY 2001 current year work plans are scheduled to be finalized by September 30, 2000.

Significant Accomplishments and Program Shifts

- In FY 1999, complete 15-20 full-scale demonstrations of innovative and improved deactivation and decommissioning technologies at four Large-Scale Demonstration and Deployment Projects.
- In FY 1999, complete deployment of remote characterization and visualization systems at the Hanford 221-U "Canyon" Facility. Ultimately, these advances will lead to the final disposition and end-state of the U-Plant and four other plutonium processing canyons at Hanford.
- In FY 2000, complete, at Savannah River, the Large-Scale Demonstration and Deployment Project for deactivation of the 321-M Highly Enriched Uranium Facility. An estimated 1,200 grams of highly enriched uranium occupies ventilation ducts, processing systems and open surfaces. Five to eight improved and innovative technologies will be demonstrated and deployed to remove the residual highly enriched uranium, allowing DOE to convert 9,000 square feet of existing contaminated area into a radiological buffer area with clearly identified islands of fixed contamination areas, thereby reducing ongoing surveillance and monitoring costs.
- In FY 2000, complete demonstration and deployment of innovative and improved technologies for the deactivation and decommissioning of Idaho National Engineering and Environmental Laboratory fuel pools and associated structures. This Large-Scale Demonstration and Deployment Project will demonstrate 15-18 technologies for underwater inspection and equipment size reduction, surface characterization and decontamination, structural dismantlement, sludge/debris removal, water treatment, and waste disposition.
- In FY 2000, deploy the Mobile Work Platform to dismantle structures at Fernald Plants 2 and 8.
- In FY 2000, deploy the Multi-Agency Radiation Survey and Site Investigation Manual methodology and two new sensors to characterize the Brookhaven National Laboratory graphite reactor.

- In FY 2000, deploy the Personal Ice Cooling System at four DOE sites.
- In FY 2000, deploy a robotic arm with tooling in Permacon enclosure at Rocky Flats Building 771 to dismantle gloveboxes.
- In FY 2000, deploy multiple technologies (10-12) at Idaho, Fernald and Argonne National Laboratory as a part of an integrated deactivation and decommissioning deployment project
- In FY 2001, complete deactivation and decommissioning of the Mound Tritium Facility Large-Scale Demonstration and Deployment Project. Due to schedule delays, funding was shifted from FY 2000 to FY 2001. This Large-Scale Demonstration and Deployment Project will showcase 8-12 innovative technologies for remote characterization, decontamination, and dismantlement of tritium-contained equipment and surfaces.
- In FY 2001, complete the Los Alamos National Laboratory Transuranic Waste Characterization and Disposition Large-Scale Demonstration and Deployment Project. Innovative technologies for characterization, decontamination, size reduction, and packaging of transuranic waste, including plutonium contaminated gloveboxes, will be showcased.
- In FY 2001, complete the Rocky Flats Initiative (RFI) to design, procure and install a Central Size Reduction Facility for plutonium-contaminated materials and equipment. This facility is essential to the accelerated closure schedule established by the Rocky Flats Office. It is anticipated that processing will begin in early FY 2002. Because of budget constraints in FY 2000, funding for the Rocky Flats Initiative was not requested. However, funding shifted from the Mound Tritium Large Scale Demonstrations and Deployment Project enabled funding of the Rocky Flats Initiative in FY 2000 which supports the accelerated closure of Rocky Flats site by FY 2006.
- In FY 2001, complete deployment initiated in FY 2000 of a highly selective ion exchange membrane system to remove targeted radionuclides and non-radioactive contaminants from liquids at the Savannah River fuel pool.
- In FY 2001, deploy the enhanced, integrated telerobotic Remote Control Concrete Demolition System (Brokk) to dismantle facilities (e.g., Tan-620) at the Idaho National Engineering and Environmental Laboratory.
- In FY 2001, deploy laser cutting system at Nevada Test Site to size reduce transuranic waste to fit into Waste Isolation Pilot Plant certified containers; technology may also be deployed at Rocky Flats Environmental Technology Site, the Los Alamos National Laboratory and Hanford.
- In FY 2001, increased emphasis will be placed on basic science and applied research to address mid to long-term deactivation and decommissioning needs.
- Beginning in FY 2001, University Program activities will no longer be a separate line item in the Office of Science and Technology budget. Consistent with the Focus Area centered approach, these activities have been included within each Focus Area's budget.

Funding Schedule

	FY 1999 Current Appropriation	FY 2000 Current Appropriation	FY 2001 Request
Reactor Facilities	9,157	8,419	3,645
Radionuclide Separation Facilities	9,322	10,189	9,462
Fuel and Weapons Component Fabrication Facilities	5,742	8,627	5,265
Laboratory Facilities	4,574	0	0
Total, Deactivation and Decommissioning Focus Area	28,795	27,235	18,372

Detailed Program Justification

(dollars in thousands)

FY 1999	FY 2000	FY 2001

Reactor Facilities

There are 14 surplus production reactors across the DOE weapons complex which represent a significant portion of the Department's long-term deactivation and decommissioning mortgage. There are also over 100 test and research reactors throughout DOE and the United States (universities) that will require deactivation and decommissioning. More than half have already been placed in shutdown mode. In addition, commercial nuclear power companies have 109 reactors. Many of these reactors are approaching their life expectancy and will require deactivation and decommissioning. Improved, innovative technologies are required to facilitate deactivation and decommissioning of these reactors to a degree such that they can be put in interim safe storage for a long period of time (up to 50 years) with minimal surveillance and maintenance requirements. In addition, highly contaminated fuel pools and associated facilities require improved technologies for characterization, decontamination and dismantlement.

The main focus of this Product Line is the decontamination and dismantling of surplus reactor facilities and related structures, including fuel storage pools associated with DOE's test and research reactors and production reactors at Hanford and Savannah River.

(dollars in thousands)

FY 1999	FY 2000	FY 2001

Technologies will be demonstrated and deployed which address underwater visual inspection, characterization and dismantlement barriers; in addition, new approaches to remove and treat fuel pool sludges, debris and water will be developed. These improved/innovative technologies will reduce the worker risk in high radiation areas, accelerate schedules, eliminate surveillance and maintenance costs and significantly reduce the cost of deactivation and decommissioning of such facilities. Technologies demonstrated should assist the commercial nuclear utility industry which also faces deactivation and decommissioning of similar complex facilities. For this reason, the commercial nuclear utility industry will be a key participant and directly involved in this effort. Without these technologies, DOE sites and private industry will have no alternative but to adhere to their original technical baselines which will incur high cost, unacceptable worker risk, and long project duration to complete deactivation and decommissioning of these facilities.

In FY 2001, there is one distinct work element which supports this Product Line: 1.) Fuel Pools and Associated Structures.

- Initiate applied research directed towards developing a better understanding of contaminated media and the depth-dependent concentration and chemistry of radionuclides in various media. This will help to establish acceptable regulatory release standards and advance innovative, more efficient decontamination methods.
- Complete deployment of a selective separation membrane system to treat radionuclides (Cs-137 and Sr-90) in fuel pool water.
- Complete development of integrated characterization sensors with remote deployment platforms and manipulators to survey high-confined spaces or remote radioactive areas.
- Initiate university technology development activities to address needs related to deactivation and decommissioning of fuel pools and associated structures at the Idaho National Engineering and Environmental Laboratory.

(dollars in thousands)

	FY 1999	FY 2000	FY 2001
# Complete the integration and deployment of the Compact Remote Console for remote viewing and tool control of the Remote Control Concrete Demolition System (Brokk) for use in areas where radiation, chemical or industrial hazards prohibit manual operation.			
Reactor Facilities	9,157	8,419	3,645

Radionuclide Separation Facilities

Separation process facilities are typically highly contaminated, aging structures and represent the second largest portion of EM's surplus facility inventory. Improved, innovative technologies are required to deactivate and decommission radionuclide separation facilities, including gaseous diffusion plants, fuel reprocessing canyons and a wide variety of specific types of facilities (such as chemical separation, uranium recycling, lithium enrichment, heavy water production and tritium production). The main focus of this Product Line is to reduce the risks and costs associated with the deactivation and decommissioning of these nuclear facilities and to lower long-term surveillance and maintenance costs.

Characterization technologies will be demonstrated and deployed which fully assess the nature and extent of contamination. Technologies to deactivate non-essential systems and utilities and decontaminate and dismantle large complex waste structures; and technologies to improve waste disposition, enhance worker safety, and utilize remote operations will be demonstrated and deployed.

In FY 2001, there are two distinct work elements which support this Product Line: 1.) Contaminated Materials Disposal and Cleanup; and 2.) Deactivation and Decommissioning of Processing Facilities.

- # Complete development of an integrated segregation system(s) to characterize and separate contaminated from non-contaminated materials, debris, and rubble. Complete similar integrated system(s) for transuranic and low-level waste.
- # Complete development of a real-time volumetric assay of lead.

(dollars in thousands)

	FY 1999	FY 2000	FY 2001
# Complete deployment of Laser Cutting System for transuranic waste			
# Initiate applied research to optimize melt decontamination processes through a basic understanding of the factors that govern the partitioning of various radionuclides between metal, slag, and gas phases.			
# Initiate applied research leading to development of a high-resolution germanium detector system for direct imaging of spent nuclear fuel, fissile materials, and large objects.			
# Initiate applied research to develop a prototype dual-manipulator mobile work cell supported by computer vision, virtual reality, and advanced robotic technology. Also initiate applied research directed towards developing monitoring & diagnostic methods for robots that will provide early detection, isolation, and tracking of impending faults before they result in serious system failure.			
# Initiate applied research to learn how ambient dust particles deposit on camera filters, reduce alpha-particle interference of radon progeny and other radioactive aerosols leading to development of more sensitive cameras.			
# Development of a telerobotic manipulation systems with integrated Task Space Analyzer for deployment of characterization, decontamination, size reduction and waste handling tools in high radiation below-grade structures and cells.			
Radionuclide Separation Facilities	9,322	10,189	9,462

(dollars in thousands)

FY 1999	FY 2000	FY 2001

Fuel and Weapons Component Fabrication Facilities

Fuel and weapons component fabrication facilities are found throughout the DOE complex and represent the largest group of surplus facilities. Improved and innovative technologies are required to deactivate and decommission fuel and weapons component fabrication facilities including those used for uranium milling and refining, weapons component fabrication and weapons assembly, dismantlement, modification and maintenance. The cost and risk of using baseline technologies for deactivation and decommissioning of these facilities is staggering. The main focus of this Product Line will be to demonstrate and deploy technologies which safely and cost effectively address the decontamination and dismantlement of such facilities.

DOE's Mound and Savannah River Sites have many structures which contain tritium contamination. Improved and innovative technologies will be demonstrated and deployed to address building and equipment characterization, decontamination and dismantlement, and metal and concrete waste disposal and recycling. Without these technologies, the DOE sites will be forced to adhere to original technical baselines that will increase the risk to workers and increase the cost and time needed for deactivation and decommissioning of these facilities.

Former plutonium manufacturing facilities at Rocky Flats, the Los Alamos National Laboratory, and Hanford are currently undergoing deactivation and decommissioning and have large volumes of transuranic contaminant materials and equipment. Rocky Flats has nearly 900 contaminated gloveboxes and miles of contaminated ventilation piping and ducts. Without improved systems to reduce the size of plutonium gloveboxes, and repackage and characterize the resulting transuranic waste, Rocky Flats cannot implement a new technical baseline for site closure in FY 2006. At the Los Alamos National Laboratory there are over 300 plutonium gloveboxes with an additional 3,000 m^3 of transuranic waste expected to be generated beginning in FY 2000. Improved characterization and size reduction technologies are required to enhance worker safety, lower life-cycle costs and accelerate schedules.

(dollars in thousands)

FY 1999	FY 2000	FY 2001

In FY 2001, there are two distinct work elements which support this Product Line: 1.) Deactivation and Decommissioning of Tritium Contaminated Facilities; and 2.) Deactivation and Decommissioning of Weapons Components Fabrication Facilities.

- # Complete Mound Tritium Deactivation and Decommissioning Large-Scale Demonstration and Deployment Project with demonstrations of innovative technologies with validated cost and performance data to characterize and treat tritium-contaminated gloveboxes, mixed waste, water and building materials.
- # Complete Los Alamos National Laboratory Oversized Metallic Transuranic Waste Disposition Large-Scale Demonstration and Deployment Project with demonstrations of innovative technologies with cost and performance for decontamination and volume reduction of oversized metallic transuranic waste in storage.
- # Complete Rocky Flats Initiative Centralized Size Reduction Facility.
- # Assuming positive phase decision in FY 2000, complete industry development of the Alpha Continuous Emission Monitoring.
- # Assuming a positive phase decision in FY 2000, complete industry development of the Self-Contained Actuator Modular Manipulator for Robotics. Applies to use-tailored systems for automated plutonium processing in restrictive or confined work spaces such as, gloveboxes.
- # Complete development and demonstration of a real-time beryllium surface characterization and air monitor.
- # Continue applied research leading to the development of a viable commercial atmospheric-pressure plasma jet for minimizing transuranic waste via the decontamination of a wide variety of structures and equipment.

	(dollars in thousands)		
	FY 1999	FY 2000	FY 2001
# Conduct applied research to develop heavy noble gas detectors for 1) long-term monitoring of transuranic, spent fuel, uranium, and thorium wastes and 2) alpha particle air monitors that discriminate between radon emissions and alpha emitters.			
Fuel and Weapons Component Fabrication Facilities	5,742	8,627	5,265
Laboratory Facilities			
Innovative and improved technologies are required to deactivate and decommission laboratory facilities including research, development and testing facilities, hot cells and gloveboxes. Across the DOE weapons complex, there is a large number of surplus plutonium contaminated gloveboxes. Technologies for characterization of contaminated surfaces to determine transuranic, low-level waste or free-release segregation and packaging of transuranic contaminated waste will be demonstrated and deployed. This will minimize the amount of glovebox material requiring disposal as transuranic waste.			
# These activities will continue under the Fuel and Weapons Component Fabrication Facilities Product Line.			
Laboratory Facilities	4,574	0	0
Total, Deactivation and Decommissioning Focus Area	28,795	27,235	18,372

Explanation of Funding Changes from FY 2000 to FY 2001

	FY 2001 vs FY 2000 ($000)
Reactor Facilities	
# Reduction reflects completion, in FY 2000, of the Idaho National Engineering and Environmental Laboratory Fuel Pools and Associated Structures Large-Scale Demonstration and Deployment Project and the continuation, at a reduced level, of technology development efforts related to inspection, characterization, and dismantlement needs associated with fuel pools and other structures	-4,774

	FY 2001 vs FY 2000 ($000)
Radionuclide Separation Facilities	
# Decrease reflects completion, in FY 2000, of the Canyon Disposition Initiative and several Accelerated Site Technology Deployment projects; offset by an increase to support initiation of a new Large-Scale Demonstration and Deployment Project to cleanup and dispose of contaminated materials and increased efforts to develop, demonstrate and deploy technologies to demonstrate remote technologies for deactivation and decommissioning process facilities	-727
Fuel and Weapons Component Fabrication Facilities	
# Decrease due to completions in FY 2000 projects, including two industry development projects and final year support (ramp down) of the Mound Tritium Deactivation and Decommissioning Large-Scale Demonstration and Deployment Project; offset by increases for the Rocky Flats Initiative Central Size Reduction Facility and the Los Alamos National Laboratory Large-Scale Demonstration and Deployment Project for Transuranic Waste Characterization and Decontamination	-3,362
Total Funding Change, Deactivation and Decommissioning Focus Area	-8,863

Nuclear Materials Focus Area

Mission Supporting Goals, and Objectives

Program Mission

The mission of the Nuclear Materials Focus Area is to develop technologies that support safe management and expeditious stabilization of nuclear materials currently under the purview of EM. The Nuclear Materials Focus Area will identify and provide technical solutions to the broad range of challenges associated with management of nuclear materials.

Program Goal

The Nuclear Materials Focus Area will support the Nuclear Materials Stewardship Program in facilitating the integrated management of DOE's excess nuclear materials. The Nuclear Materials Focus Area will address technologies to meet nuclear material needs and requirements within the purview of EM. Nuclear materials includes those materials held under the purview of other DOE programs, but stored in EM facilities or sites. However, the scope excludes nuclear weapons components and materials not yet transferred to EM. The specific materials scope of the Nuclear Materials Focus Area encompasses: transuranic isotopes; uranium/thorium; isotope materials and scaled sources; and all material contained in the Defense Nuclear Facilities Safety Board recommendations 94-1 and 97-1.

Management of these materials presents significant challenges due to the amounts and forms of materials, associated health risks, accelerated cleanup commitments, reduced budgets, and non-proliferation concerns. In addition, the lack of knowledge and expertise in dealing with many aspects of nuclear material management has resulted in considerable technology gaps. The Nuclear Materials Focus Area will build on the existing systems and efforts to identify technology gaps or needs, to ensure that a plan for developing and deploying technology solutions is established, and foremost, that end-user needs are met on a timely basis. The Nuclear Materials Focus Area will work to assure that DOE meets its milestones to stabilize and disposition nuclear materials that pose risks as addressed in Defense Nuclear Facilities Safety Board Recommendations 94-1 and 97-1. Within the funding provided, the Nuclear Materials Focus Area will work with site project leads to deploy technologies at individual sites and implement and maintain sound program management and integration practices.

Program Objectives

The objective of the Nuclear Materials Focus Area is to conduct a research and development program using a systems engineering approach to:

- develop and deploy new technologies for nuclear materials stabilization and disposition;
- enable progress towards meeting EM sites' baseline planning objectives;
- develop integrated solutions by building on existing systems and efforts and identifying any technology gaps in the steps to stabilize, store, and finally dispose of nuclear materials;
- provide support to meet DOE milestones to satisfy Defense Nuclear Facilities Safety Board Recommendations 94-1 and 97-1 as originally scheduled or as revised; and
- effectively coordinate plans and resolutions between the Nuclear Materials Focus Area and other Focus Areas; the EM Science Program, University and Industry; Site Technology Coordination Groups; and with the EM Office of Nuclear Material and Facility Stabilization.

Performance Measures

The Science and Technology FY 2001 corporate performance metrics (25 technologies or technology systems demonstrated; 32 technologies or technology systems made ready for implementation; 60 alternative technologies deployed) are set at the Project Baseline Summary level, based on past program performance and the budget requested. The complete listing of specific technologies, by Focus Area, that will be demonstrated, made ready for implementation or deployed, is made available after the final FY 2001 project level funding is known and FY 2001 current year work plans are finalized by each Focus Area. FY 2001 current year work scheduled to be finalized by September 30, 2000.

Significant Accomplishments and Program Shifts

In April 1999, the Nuclear Materials Focus Area was formed by the merger of the Plutonium Focus Area within the EM Office of Science and Technology and the Nuclear Materials Stewardship Technology Development Program within the EM Office of Nuclear Materials and Facility Disposition. A major program shift, the newly chartered Nuclear Materials Focus Area provides for the continuity of the existing programs and builds on the existing technical capabilities. The program is end-user oriented in terms of focusing its activities on technology user needs. This emphasis on technology user needs will facilitate accelerated deployment of new and cost effective technologies to accomplish the EM sites' baseline planning goals and milestones.

- In FY 2000, demonstrate performance of porous crystalline matrix materials to absorb and stabilize significant quantities of problematic actinide solutions.

- # In FY 2001, implement several process flow adjustments for Rocky Flats materials stabilization.
- # In FY 2001, resolve gas generation components and limits for stabilized materials in long-term storage.
- # In FY 2001, demonstrate removal of plutonium surface contamination from uranium to enable shipment of components.
- # In FY 2001, deploy a vacuum transfer system at Fernald for repackaging enriched uranium.
- # In FY 2001, increased emphasis will be placed on basic science and applied research to address mid to long-term stabilization and disposition of nuclear materials.

Funding Schedule

	FY 1999 Current Appropriation	FY 2000 Current Appropriation	FY 2001 Request
Stabilization	3,975	2,919	5,349
Packaging Transportation and Storage	2,060	1,216	3,292
Total, Nuclear Materials Focus Area	6,035	4,135	8,641

Detailed Program Justification

(dollars in thousands)

FY 1999	FY 2000	FY 2001

Stabilization

(dollars in thousands)

FY 1999	FY 2000	FY 2001

Stabilization of nuclear materials remains a high priority activity within EM to satisfy both Defense Nuclear Facilities Safety Board and stakeholder agreements. In many cases, stabilization progress is a key element of site closure because stabilization is required before the material can be shipped to a receiver site. For plutonium materials, the lack of adequate moisture measurement technique presents a major obstacle in satisfying long-term storage standards. This product line will extend direct measurement techniques that have been developed for relatively pure materials to residues and investigate the development of noninvasive techniques to measure moisture and other impurities. For plutonium contaminated materials, research will be performed to develop technologies to process them within current operational constraints and allow appropriate waste disposal. In some cases, the material is classified in its current form, limiting disposition options. Failure to perform this work will result in reduced facility safety, missed Defense Nuclear Facilities Safety Board milestones, failure to satisfy compliance agreements, increased safeguards and security costs, delays in facility closures, and delays in site closures.

Research and development is required on a number of materials processing techniques to address the widely varying chemical and physical forms of the materials currently in EM custody. In many cases the development of alternatives to traditional methods of material processing are required due to facility closure or in response to stakeholder agreements. Research efforts span a variety of technologies but focus on satisfying closure site requirements. Aqueous processing research will address special problems related to processing certain Rocky Flats residues in Savannah River canyons as well as alternatives to canyon processing to separate uranium from plutonium. Technology will be developed to remove plutonium surface contamination, primarily from uranium parts, so that the recycled uranium can be reused by other programs. Other research will develop technologies to remove the classified characteristics of components remaining at Rocky Flats within operational constraints of the site. Failure to perform this work will result in reduced facility safety, missed Defense Nuclear Facilities Safety Board milestones, breached stakeholder agreements, increased safeguards and security costs, delays in facility closure, and delays in site closure.

(dollars in thousands)

FY 1999	FY 2000	FY 2001

In FY 2001, two distinct work elements support this Product Line: 1.) Contaminant Removal for Stabilization and 2.) Develop Processing Methods for Materials Disposition.

- Demonstrate and deploy at Rocky Flats, Los Alamos National Laboratory, Lawrence Livermore National Laboratory, and Savannah River alternative unique moisture measurement techniques.
- Implement several process flow adjustments for Rocky Flats materials stabilization.
- Complete examination of failed filters or Rocky Flats residue drums; evaluate probable cause and propose corrective measures.

	(dollars in thousands)		
	FY 1999	FY 2000	FY 2001
Stabilization	3,975	2,919	5,349

Packaging, Transportation and Storage

The packaging and transportation of nuclear materials is a critical element of the EM sites' baseline planning strategy. Failure to remove these materials from key facilities will make it impossible for EM to satisfy stakeholder agreements and achieve mortgage reduction goals. Some of these nuclear materials exist in chemical and physical forms that were not historically transported in the complex. Their transportation is now necessary due to a lack of processing capabilities at many sites. Unsettled issues regarding potential gas generation drastically limit the transportation of nuclear materials within the complex. This product line addresses this issue through both an experimental effort to measure gas generation rates for selected materials and the longer term development of a modeling capability to predict gas generation rates for other materials. Another issue limiting the packaging of nuclear materials is worker radiation exposure. Limited numbers of trained radiation workers remaining in the complex, combined with the need to maintain low individual exposure levels, has already limited packaging operations at some sites. This product line will develop techniques to automate packaging processing and increase packaging rates. Failure to address these issues will result in increased worker radiation exposure, failure to satisfy stakeholder agreements, increased safeguards and security costs, delays in facility closure, and delays in site closure.

(dollars in thousands)

	FY 1999	FY 2000	FY 2001
Long-term safe storage of nuclear materials is an essential element of the Department's nuclear material management strategy. For example, EM has been approached to prepare plutonium materials capable of being stored up to 50 years. Storing radioactive elements and their corrosive constituents at elevated temperatures for extended periods of time presents a number of technical challenges. This product line will perform detailed investigations of the potential corrosion problems in this environment. Accelerated aging studies will be used to anticipate material chemical and physical changes under appropriate storage conditions. Concerted efforts will be made to develop a predictive model for identifying potential storage problems and determining ultimate storage limitations. Failure to perform this work will result in reduced facility safety, missed Defense Nuclear Facilities Safety Board milestones, failure to satisfy stakeholder agreements, increased safeguards and security costs, delays in facility closure, and delays in site closure.			
In FY 2001, there are two distinct work elements that support this product line: 1.) Characterization and Control of Gas Generation for Transportation and Storage; and 2.) Studies of Materials Compatibility for Long-Term Storage of Nuclear Material.			
# Conduct technology development focused on resolving gas generation components and limits for stabilized nuclear materials in long-term storage.			
# Complete gas evolution experimentation to assure that plutonium materials can be shipped safely.			
# Demonstrate removal of plutonium surface contamination from uranium to enable shipment of components.			
# Deploy vacuum transfer system at Fernald for repackaging enriched uranium.			
Packaging, Transportation and Storage	2,060	1,216	3,292
Total, Nuclear Materials Focus Area	6,035	4,135	8,641

Explanation of Funding Changes from FY 2000 to FY 2001

	FY 2001 vs FY 2000 ($000)
Stabilization	
# Increase in stabilization technology development activities to address DOE complex needs relating to stabilization and disposition of nuclear materials	2,430
Packaging, Transportation, and Storage	
# Increase due to technology development activities focused on packaging, transportation and storage of nuclear materials across the DOE complex	2,076
Total Funding Changes, Nuclear Materials Focus Area	4,506

Environmental Systems Research and Analysis

Mission Supporting Goals, and Objectives

Program Mission

The mission of the Environmental Systems Research and Analysis program is to support the EM program and the Focus Areas through technology systems research and analysis activities that support the deployment and application of innovative EM technologies across the DOE complex; provide basic and applied research to address risks and technical gaps in EM's baseline; and support systems engineering activities which will be used in the development of disposition processes for each EM waste stream. Continued activities will secure environmental programs on a solid technical base, reduce costs, and leverage the DOE cleanup investment into broader national environmental priorities.

Program Goal

The goal of the Environmental Systems Research and Analysis Program is threefold: 1.) to provide the Focus Areas and EM program processes that will assist EM in focusing activities on accelerating cleanup; 2.) to investigate alternatives to the baseline using innovative technologies; and 3.) to track performance of these efforts.

Program Objectives

The primary objective of the Environmental Systems Research and Analysis Program is to support EM in identifying current and potential integration problems. The program analyzes complex-wide integration opportunities to reduce program costs and risks.

Performance Measures

Deployments of innovative technologies which are supported through program activities are captured under EM's corporate performance measures.

Significant Accomplishments and Program Shifts

- In FY 1999, general analysis method was developed for applications involving passive gamma Non Destructive Assay instruments and large volume containers (e.g. barrels and boxes). In addition, analysis methods for examining gamma-ray spectra produced by simple passive gamma-ray assay instruments were perfected. The program developed a method for analyzing the prompt gamma-ray spectra taken by in-field neutron activation Non-Destructive Assay instruments. Research supporting the transport of radiation from its source to the detector involving complex geometries found in field applications of Non-Destructive Assay. This development is expected to greatly expand the role of less expensive passive gamma Non-Destructive Assay instruments in area involving nuclear waste characterization.
- In FY 2000, quantify biotic and abiotic processes which control the generation, consumption, and/or transport of reactive vadose zone gases, such as, carbon dioxide and oxygen relative to subsurface environmental contaminant fate and transport for incorporation into appropriate vadose zone and groundwater transport models.
- In FY 2000, demonstrate the spatial relationship of biofilms formed by microorganisms isolated from spent fuel storage pool, and its relationship to metallurgical defects in aluminum and iron based structural alloys. Demonstration will be through development of an increased understanding of the role of microorganisms in biologically-induced or assisted corrosion of spent nuclear fuel materials and containers through combined metallurgical and electrochemical measurements of pitting corrosion in the presence of biota compared to sterile controls.
- Beginning in FY 2001, funding for the Environmental Systems Research and Analysis program will be requested in the Idaho Defense Site Project Completion and Post 2006 Completion accounts.

Funding Schedule

	FY 1999 Current Appropriation	FY 2000 Current Appropriation	FY 2001 Request
Environmental Systems Research Analysis	5,500	14,500	0
Complex Wide Environmental Management Integration	8,000	8,000	0
Total, Environmental Systems Research and Analysis	13,500	22,500	0

Detailed Program Justification

(dollars in thousands)

	FY 1999	FY 2000	FY 2001
Environmental Systems Research and Analysis			
Environmental Systems Research and Analysis activities will be used to support EM in its long-term stewardship mission through the development and maintenance of critical environmental science capabilities. Environmental Systems Research and Analysis research augments EM's ability to transition basic science to engineering application and problem solution and enhances the ability of the Office of Science and Technology to provide technical assistance to the end-users.			
# Beginning in FY 2001, funding for the Environmental Systems Research and Analysis program will be requested in the Idaho Defense Site Project Completion and Post 2006 Completion accounts.			
Environmental Systems Research and Analysis	5,500	14,500	0
Complex-Wide Environmental Management Integration			
Systems Engineering activities will be used to refine EM waste, spent nuclear fuel, and nuclear materials disposition baselines, and to identify and implement new opportunities to accomplish more efficient and cost effective cleanup/closure of DOE sites. Systems engineering activities provide the information and communication tools necessary to maximize the use of existing facilities, minimize duplication, share technical information, promote cost savings, and a systems approach to EM cleanup activities. Integration facilitates accelerated cleanup and reduces closure costs and risks. Implementation of systems engineering processes brings together EM waste, spent nuclear fuel, and nuclear materials management, site cleanup, transportation, and science and technology development activities. EM integration eliminates program and site barriers by encouraging communication and interaction with other Departmental programs. The revamped system reveals cross-site and cross-program opportunities to reduce costs, streamline processes and implement accelerated cleanup programs.			

(dollars in thousands)

	FY 1999	FY 2000	FY 2001
EM integration activities use multi-site teams to develop, evaluate, and recommend alternatives to existing waste, spent nuclear fuel, and nuclear materials disposition baselines. DOE, contractor management personnel, and subject matter experts from DOE EM sites are represented during the integration process. These activities are fundamental to the EM integration effort to establish and communicate a credible waste, spent nuclear fuel, and nuclear materials disposition baseline, and identify, evaluate, and implement selected efficiency opportunities.			
# Beginning in FY 2001, funding for the Environmental Systems Research and Analysis program will be requested in the Idaho Defense Site Project Completion and Post 2006 Completion accounts.			
Complex-Wide Environmental Management Integration	8,000	8,000	0
Total, Environmental Systems Research and Analysis Program	13,500	22,500	0

Explanation of Changes from FY 2000 to FY 2001

	FY 2001 vs FY 2000 ($000)
Environmental Systems Research and Analysis	
# Beginning in FY 2001, funding for the Environmental Systems Research and Analysis program will be requested in the Idaho Defense Site Project Completion and Post 2006 Completion accounts	-14,500
Complex-Wide Environmental Management Integration	
# Beginning in FY 2001, funding for the Environmental Systems Research and Analysis program will be requested in the Idaho Defense Site Project Completion and Post 2006 Completion accounts	-8,000
Total Funding Changes, Environmental Systems Research and Analysis	-22,500

Technology Acceptance and Support

Mission Supporting Goals, and Objectives

Program Mission

The mission of the Technology Acceptance and Support program is to assist EM's Office of Science and Technology with strategic planning; encourage broad acceptance and deployment of emerging technologies; to ensure collection, analysis, and communication of project specific data and program information; to facilitate within the Office of Science and Technology sound business management practices; to interact with the international scientific and technical community; and to assist in science and technology laboratory management policy and review.

Program Goal

The goal of the Technology Acceptance and Support program is two-fold. First, Technology Acceptance and Support will facilitate wider acceptance and deployment of Focus Area technologies by providing technology information to EM management systems, delivering program and policy reviews and analysis, improving Focus Area responsiveness to site needs, encouraging regulatory acceptance of the Office and Science and Technology technologies, and leveraging of international scientific and technical expertise. Second, Technology Acceptance and Support will facilitate effective management processes within the Office of Science and Technology, including information management, creation and dissemination of communication products, and business process assistance.

Program Objectives

The Technology Acceptance and Support program objectives are to provide: strategic planning assistance to the Office of Science and Technology; technology and overall program information collection, analysis, and dissemination; facilitating effective business management practices; program and peer reviews of technology initiatives; clarification of site science and technology needs to ensure responsive Focus Area activities and technologies; facilitation of rapid technology deployment; support to interstate regulatory cooperation initiatives for the use of innovative technologies; facilitation of international science and technology cooperation; recommendations for enhancing technology worker safety; and facilitation of programmatic policy recommendations for and reviews of research and development programs at EM laboratories.

Performance Measures

Deployments of innovative technologies, which are supported through program activities are captured under EM's Corporate Performance.

Significant Accomplishments and Program Shifts

- Continue in FY 2000 and FY 2001, to maintain information and other communication tools to aid in overall Office of Science and Technology business and program management.
- Update and continue in FY 2000 and FY 2001, life-cycle impact estimates for innovative technologies, with emphases on potential cost savings, using the EM standardized methodology developed under this program.
- In FY 2001, initiate laboratory management and policy review activities.
- Continue in FY 2000 and FY 2001, conducting independent reviews of Office of Science and Technology programs and significant processes and provide peer reviews of Office of Science and Technology technologies. In FY 2000, approximately 50 percent of actively funded technologies will be peer reviewed; in FY 2001, 75 percent will be peer reviewed.
- Continue in FY 2000 and FY 2001, to assist all participating states in eliminating acceptance barriers to technology deployment through common protocols, training, improved state practices, and deployment workshops.
- Continue in FY 2000 and FY 2001, update of site science and technology needs and responsive Focus Areas activities and technologies.
- Continue in FY 2000 and FY 2001, to provide recommendations for enhancing worker safety, reducing fatigue and stress; greater user acceptance, efficiency, and productivity for Office of Science Technology technologies.
- Continue in FY 2000 and FY 2001, the National Energy Technology Laboratory's Center for Acquisition and Business Excellence participation in the Office of Science and Technology's business management activities.
- Continue in FY 2000 and FY 2001, to facilitate access to international technology expertise.
- Technology cost savings and life-cycle systems analysis activities previously included in the Western Environmental Technology Office budget line are included within the Technology Acceptance and Support budget.

Funding Schedule

	FY 1999 Current Appropriation	FY 2000 Current Appropriation	FY 2001 Request
Program Information, Review and Analysis	9,441	10,640	8,365
Regulatory and Site Acceptance	7,914	6,479	5,929
International Technology Coordination	650	600	600
Safety Testing	2,000	2,000	2,000
Total, Technology Acceptance and Support	20,005	19,719	16,894

Detailed Program Justification

(dollars in thousands)

FY 1999	FY 2000	FY 2001

Program Information, Review, and Analysis

Sound program articulation, justification, management, and deployment of innovative technologies require strategic planning, ongoing programmatic and technology reviews, information systems, communication products, and analysis. Activities will focus on providing and improving effective and credible information and information management systems; communications planning and products; business management support; independent program and technology assessments and peer reviews; assistance to and consolidation of field cost savings analysis; and facilitation of EM laboratory management policy and review. Without these various programs and activities, EM decision-makers would not have the information needed to support science and technology programmatic and deployment decisions or document impacts of deployments.

- # Continue providing key information and communication tools to aid in overall Office of Science and Technology business and program management. Identify and meet the dynamic communication needs of existing and additional audiences as technology solutions mature. Facilitate the implementation of improved management processes.

(dollars in thousands)

	FY 1999	FY 2000	FY 2001
# Update and continue life-cycle impact estimates for innovative technologies, with emphasis on potential cost savings, using the EM standardized methodology.			
# Continue conducting independent review of Office of Science and Technology programs and significant processes, and provide peer reviews of approximately 75 percent of actively funded technologies and provide EM laboratory management and policy recommendation analyses .			
Program Information, Review, and Analysis	9,441	10,640	8,365

Regulatory and Site Acceptance

Site, program, and Focus Area plans to deploy innovative technologies can be delayed or curtailed by lack of state acceptance and integration of site needs among end users, stakeholders, and developers. Activities will focus on conducting new and continuing workshops on key technology and problem areas through the Interstate Technology Regulatory Cooperation, conducting field Science and Technology project management activities through the Technical Program Officer, providing site Science and Technology needs, deployment assistance, and data for EM research and development planning through the Site Technology Coordination Groups, conducting strategic planning and consensus-building through the Strategic Laboratory Council, and continuing facilitation of rapid deployments. Without these activities, barriers to deployment would not be overcome and regulatory acceptance may not occur.

Continue to assist all participating states in eliminating acceptance barriers to deployment through common protocols, systems and training and deployment workshops. Reduce DOE funding requirements for Interstate Technology and Regulatory Cooperation workgroup by encouraging increased state, other Federal, private sector, and other funding participation. Continue to document use of Interstate Technology and Regulatory Cooperation workgroup publications and technology deployments.

(dollars in thousands)

	FY 1999	FY 2000	FY 2001
# Update site science and technology needs, and continue to support management of site science and technology activities. Facilitate communications among site stakeholders and technology developers in order to catalyze the use of innovative science and technology solutions and pursue other activities to facilitate rapid deployment.			
Regulatory and Site Acceptance	7,914	6,479	5,929

International Technology Coordination

The EM mission will not be enhanced or completely supported without access to international environmental technologies, scientific expertise, technical information and foreign demonstration sites. Through Memoranda of Cooperation, the Office of Science and Technology collaborates with the scientific communities of Russia, Poland, Argentina and other areas as appropriate, in joint research and development to meet these needs. These efforts ensure continued awareness of opportunities for site users to access relevant foreign environmental technologies, data, and expertise to accelerate cleanup. Through these activities, the Office of Science and Technology leverages the relationships established with the international science and technology community over the past 10 years to maintain access to foreign technologies with minimal increase in investment. Without these efforts, EM sites will not effectively receive the benefit of international technologies and expertise.

# Continue ongoing coordination and identification of available opportunities for EM participation with the international science and technology community. Level of effort for this activity will remain constant. Work is conducted with Argentina, Poland, and Russia under bilateral agreements.			
International Technology Coordination	650	600	600

	(dollars in thousands)		
	FY 1999	FY 2000	FY 2001
Safety Testing			
DOE site cleanup work can be performed more responsibly and effectively through technology improvements that increase safety and contribute to user and worker acceptance of those technologies. The Technology Acceptance and Support program conducts worker safety assessments of high impact environmental technologies to improve technology safety, reduce worker fatigue and stress, increase comfort, and gain increased user and worker acceptance. Without this activity, user and worker acceptance may be reduced, potentially lessening benefits from Office of Science and Technology investments.			
# Perform human factors assessments on key Focus Area identified technologies.			
Safety Testing	2,000	2,000	2,000
Total, Technology Acceptance and Support	20,005	19,719	16,894

Explanation of Changes from FY 2000 to FY 2001

	FY 2001 vs FY 2000 ($000)
Program Information, Review, and Analysis	
# Decrease primarily related to reduced cost savings and life-cycle systems analysis activities and a reduction in technology verification support	-2,275
Regulatory and Site Acceptance	
# Decrease reflects planned reduction, in FY 2001, for the Interstate Technology Regulatory Cooperation workgroup as other funding sources (state, other Federal, private sector, etc.) are developed and a small reduction in deployment assistance activities	-550
Total Funding Change, Technology Acceptance and Support	-2,825

Small Business Innovative Research Program (Technology Development)

Mission Supporting Goals, and Objectives

Program Mission

Provide funding to the Small Business Innovative Research program for small businesses to participate in research and development activities that benefit the EM program.

Program Goal

The goal of this program is to use technologies developed by the small business community to accelerate and reduce the cost of cleanup at EM sites.

Program Objectives

The objective is to deploy technologies that meet the EM mission as rapidly as possible.

Performance Measures

There are no quantifiable corporate performance measures associated with this program.

Significant Accomplishments and Program Shifts

- Continue to support this program and provide opportunities for the small business community to make contributions to the EM mission.

Funding Schedule

	FY 1999 Current Appropriation	FY 2000 Current Appropriation	FY 2001 Request
Small Business Innovative Research Program (Technology Development)	0 [a]	3,800	1,500

Detailed Program Justification

(dollars in thousands)

	FY 1999	FY 2000	FY 2001
Small Business Innovative Research Program (Technology Development)			
Funding is requested for the Small Business Innovative Research assessment in accordance with Public Law 102-564, which mandates a percentage of all research and development dollars be set aside for grants to small businesses. Once funding is appropriated, it is transferred to the DOE Office of Science for award and administration of grants to small businesses.			
Small Business Innovative Research Program (Technology Development	0	3,800	1,500
Total, Small Business Innovative Research Program (Technology Development	0	3,800	1,500

Explanation of Changes from FY 2000 to FY 2001

	FY 2001 vs FY 2000 ($000)
Small Business Innovative Research Program (Technology Development)	

[a] $2,404,000 transferred to DOE Office of Science for award and administration of grants to small businesses.

	FY 2001 vs FY 2000 ($000)
# Decrease reflects smaller assessment due to reduction of budget request for Science and Technology program from FY 2000 to FY 2001	-2,300
Total Funding Change, Small Business Innovative Research Program	-2,300

Environmental Management Science Program

Mission Supporting Goals, and Objectives

Program Mission

The mission of the Office of Science and Technology's Science Program is to develop and fund a targeted long-term basic research program that will result in transformational or breakthrough approaches for solving the Department's environmental problems. This program is a collaborative effort between the Department's Office of Environmental Management and Office of Science.

Program Goal

The goal of the Office of Science and Technology's Science Program is to continue to solicit and support world class basic research that has the potential to lead to significant, quantum improvements in the understanding of scientific principles and phenomena in areas of interest to the EM mission; to validate existing technical solutions to complex problems; to provide technical solutions where currently there are none; and to lead to future risk reduction and cost and time savings.

Program Objectives

The Environmental Management Science Program, and DOE's Office of Science Program are collaborating to fund longer-term basic research to solve intractable problems that threaten the successful closure of DOE sites.

The Environmental Management Science Program is the lead organization for the planning and budgeting of the program. The Office of Science Program is responsible for ensuring that the research projects have scientific merit and that research is coordinated with similar programs within DOE and other agencies. DOE-Idaho and the Focus Areas assists in identifying needs, involving stakeholders, managing financial aspects, and getting research results to EM end-users.

The Environmental Management Science Program works with the Focus Areas to provide assurance that basic scientific knowledge is advanced to support the development of cutting-edge environmental technologies. Delivery of innovative technologies to accomplish faster, lower risk, more complete, and cheaper cleanup is possible only if a scientific knowledge base exists to support new technology development activities.

The importance of basic scientific research to the EM cleanup mission has been established in several reports, specifically the Galvin Commission report (1995) entitled *Alternative Futures for the Department of Energy National Laboratories* and the National Research Council report (1996) entitled *Improving the*

Environment: An Evaluation of DOE's Environmental Management Program. In May 1998, the Science Program received a "HAMMER" award from the Vice President's National Performance Review Team. The most recent review of the program by the Environmental Management Advisory Board Science Committee has shown that the EM Science program has made outstanding progress in getting established, getting new researchers involved, and getting new subject matter under study.

The Environmental Management Science Program's portfolio addresses the most challenging technical problems of EM related to high-level waste; remedial action including vadose zone; deactivation and decommissioning; and health, ecology, and risk including health effects of low dose radiation. Each new solicitation supports EM's needs. Work is ongoing with the National Research Council of the National Academy of Sciences to ensure long-term research agendas are prepared for the Department's most intractable problems (high-level waste, D&D, subsurface contaminant, vadose zone). In FY 2000, competitive renewal research grants will be awarded to the 20 to 30 most promising research projects originally funded in FY 1996 and FY 1997. No new basic science grants will be awarded in FY 2001.

Performance Measures

The Environmental Management Advisory Board Science Subcommittee and National Research Council of the National Academies of Science have recommended peer review as a performance measure of this program. All awards are selected through a peer merit and relevance peer review process. Results from the awards will be published in peer-reviewed journals.

Significant Accomplishments and Program Shifts

The scientific research is expected to provide a better understanding of waste properties, characterization and monitoring techniques, treatment processes, storage and shipping issues, and disposal and disposition processes. Research results will:

- Provide new understanding of collodial agglomerates in tank sludge to improve retrieval of high- level waste and potentially reduce cost of retrieval.
- Develop ligand designs and crown compounds for selective complexation to improve solvent extraction and ion exchange processes to separate contaminants in high-level and mixed wastes.
- Provide new knowledge on properties of heat-treated silicotitanate to improve high-level waste treatment process.
- Provide new knowledge and processes on plant genes and the mechanisms by which plants uptake metals, radionuclides, and chlorinated hydrocarbons to develop phytoremediation cleanup methods for soils and groundwater.
- Provide better understanding of the mineral surface processes responsible for movement of cesium into the

vadose zone from high-level waste tank releases at Hanford.

- Provide new understanding of fluid flow and contaminant transport in a fractured vadose zone at Hanford and the Idaho National Engineering and Environmental Laboratory.
- Develop laser ablation and spectrometric techniques for monitoring waste streams and decontaminating surfaces.
- Develop real-time identification and characterization of asbestos and concrete materials with radioactive contaminants.
- Develop simple, multianalyte sensors for remote environmental analysis.
- Develop a radiation resistant bacterium for biodegradation of mixed wastes.
- Develop a high-fluence neutron source for nondestructive characterization of nuclear waste.
- Provide a new understanding of the chemical and structural properties of actinides and radionuclides for safe storage of nuclear materials.
- Provide new information on the thermodynamics involved with the volatilization of actinide metals in high temperature of radioactive wastes.
- Provide new understanding of the behavior of long-lived radionuclides under high temperatures and over geologic time scales.
- Identification of biological pathways and effects of contaminants to determine level of risk.
- Identification of methods for determining the human health toxicity of contaminants.
- Evaluation of low dose effects from radiation on human health.
- Improved detection of hazardous conditions and development of protective clothing.
- Evaluation of methods for assessing worker exposure, including safety risk during restoration activities.
- Understanding of soil properties and microorganism ecology to determine uptake of contaminants.
- Understanding how restoration activities affecting surface water, groundwater, ecological systems, and emissions generated by restoration activities impact the environment.

As the EM Science Program matures, it will continue to fund basic research and development to address the evolving science needs of EM sites. The program intends to ensure that it is addressing the right research questions, disseminating research results, and getting the "best science" by:

- Awarding competitive renewal research awards to the 20 to 30 most promising research projects originally funded in FY 1996 and FY 1997.
- Evaluating ongoing research.

- Communicating the nature of the program, and its research results, to as wide an audience as possible.
- Holding site-specific, problem-specific and complex-wide workshops to link basic research developed within and outside the Department, with technology users, both within, and outside the Department. The first complex-wide workshop was held in July 1998 and the American Chemical Society hosted a session on the Environmental Management Science Program research at their national symposium in Summer 1999. Over 120 Environmental Management Science Program researchers presented papers during this national meeting. A second complex-wide workshop is planned for April 2000.
- Developing a national science research plan based on needs identified by sites through the project baseline summaries and in consultation with scientific experts. The National Academy of Sciences/National Research Council will complete plans for high-level waste and deactivation and decommissioning in 2000. Two additional plans will be developed in 2001.
- Coordinating and leveraging research efforts and capabilities with other DOE programs, other Federal agencies, academia, and the private sector.

The EM Science program supports DOE's strategic goal to deliver the scientific understanding and technological innovations that are critical to the success of DOE's mission and the nation's science base. The program directly supports the objective to develop the science that underlies DOE's long-term mission.

Funding Schedule

	FY 1999 Current Appropriation	FY 2000 Current Appropriation	FY 2001 Request
FY1996 Awards	20,512	0	0
FY 1997 Awards	8,035	7,924	0
Integration of Research Results into the Program	1,880	1,500	1,500
FY 1998 Awards	3,379	10,400	6,700
FY 1999 Awards	12,032	6,011	12,630
FY 2000 Awards	0	5,400	5,495
Small Business Innovative Research Program	0	765	675
Total, Environmental Management Science Program	45,838	32,000	27,000

Detailed Program Justification

(dollars in thousands)

	FY 1999	FY 2000	FY 2001
FY 1996 Awards			
In FY 1996, 136 three-year research projects at 52 universities, 11 Department of Energy national laboratories and other private and public technology developers and researchers were initiated. Seventy-one of the projects focused on science needed to improve remedial action processes; 26 focus on finding better ways to treat and destroy high-level radioactive waste, 23 focus on waste containing a mixture of radioactive and other hazardous materials (mixed waste); 10 focus on better understanding the health and ecological risks associated with environmental cleanup options; and the remaining six focus on technical problems with facility deactivation and decommissioning and spent nuclear fuel stabilization and disposal. The national laboratory research project funding is focused on problems in the areas of: subsurface contaminants (48%); radioactive tank waste (24%), mixed waste characterization, treatment, and disposal (15%), decontamination and decommissioning (4%), nuclear materials (2%), and health/ecology/risk (7%).			
# In FY 1999, completed funding for grants initiated in FY 1996. Final reports will be submitted within 90 days of research completion. Final reports will be available in FY 2000.			
FY 1996 Awards	20,512	0	0

(dollars in thousands)

	FY 1999	FY 2000	FY 2001
FY 1997 Awards			
In FY 1997, 66 additional three-year research projects were initiated. Over half of the 66 award recipients are collaborative efforts among universities, laboratories and private industry. Of these projects, 28 are led by universities; 31 by DOE national laboratories; and seven by private industry, nonprofit research centers, and other Federal laboratories. Twenty-two of the projects focus on finding better ways to treat and destroy high-level radioactive waste; nine focus on waste containing a mixture of radioactive and other hazardous materials; five focus on spent nuclear fuel treatment and destruction; and six address the materials used in weapons production (nuclear materials). The remaining 24 projects deal with the science needed to improve remedial action processes, to safely carry out deactivation and decommissioning of DOE sites, and to better understand the health and ecological risks associated with environmental cleanup options. The research funded at the national laboratories is focused on problems in the areas of: radioactive tank waste (43%), nuclear materials (18%), subsurface contaminants (14%), decontamination and decommissioning (8%), mixed waste characterization, treatment, and disposal (4%), spent nuclear fuel (4%), and research projects supporting multiple categories (9%).			
# In FY 2000, complete funding for grants initiated in FY 1997. Final reports will be submitted within 90 days of research completion. Final reports will be available in FY 2001.			
FY 1997 Awards	8,035	7,924	0

(dollars in thousands)

	FY 1999	FY 2000	FY 2001
FY 1998 Awards			
In FY 1998, 33 additional three-year research projects were initiated involving 23 universities, 6 DOE national laboratories and seven private industry or other Federal laboratories, in 20 states. A total of two-thirds of the 33 award recipients are collaborative efforts among universities, laboratories and private industry. Of these projects, nine are led by universities; 22 by DOE national laboratories; and two by private and other Federal laboratories. Twenty of the projects focus on finding better ways to treat and destroy high level radioactive waste and 13 deal with the science needed to improve and safely carry out the deactivation and decommissioning of DOE sites. The research funded at the national laboratories is focused on problems in the area of radioactive tank waste (64%) and decontamination and decommissioning (36%).			
# Continue to support grants in the areas of high-level waste and decontamination and decommissioning.			
FY 1998 Awards	3,379	10,400	6,700
FY 1999 Awards			
In FY 1999 31 three-year research awards to 20 universities, 8 DOE National Laboratories and 3 other research institutions were initiated to address scientific problems associated with vadose zone, subsurface contamination, and groundwater issues to support initiatives at sites such as Hanford. In addition, 8 research awards at 4 universities and private research institutions and 2 DOE National Laboratories were initiated to develop a better scientific basis for understanding exposures and risks to humans from low dose radiation. Research was selected based on its scientific merits and its relevance to the EM mission.			
# Continue to support research awards in the area of vadose zone, subsurface contamination and groundwater and in the area of exposures and risks from low dose radiation.			
FY 1999 Awards	12,032	6,011	12,630

(dollars in thousands)

	FY 1999	FY 2000	FY 2001
FY 2000 Awards			
FY 2000 awards will be made by September 2000 to address scientific issues associated with subsurface contamination/vadose zone, high-level waste; mixed waste, spent nuclear fuel, nuclear materials, decontamination and decommissioning and health/ecology/risk problems facing the Environmental Management program. These awards will be renewals of research projects initiated during FY 1996 and FY 1997 under the EM Science Program.			
# Issue new awards to address scientific issues associated with the areas of high-level waste, nuclear materials, and deactivation and decommissioning.			
FY 2000 Awards	0	5,400	5,495
Integration of Research Results into the Program			
Management, analysis, and integration. Success of the EM Science Program is dependent on the application of scientific results in EM Focus Areas and directly in field activities, enhancing EM's ability to meet compliance requirements.			
# Disseminate FY 1996, FY 1997, and FY 1998 research results to EM project managers based on science needs and problem areas and to potential technology developers. Provide links with DOE project managers, research community, and potential technology users.			
# Conduct topical workshops and seminars on specific science topics and/or site specific topics to disseminate results in a timely manner. Conduct a second complex-wide workshop to link basic research developed in the program with technology developers in April 2000.			
# Implement process with the Focus Areas to review the results of research awards from FY 1996 and FY 1997 to determine if the next step is additional follow-on basic research, applied research, incorporation of results directly into technology development, or direct application of results to an EM problem area.			

	(dollars in thousands)		
	FY 1999	FY 2000	FY 2001
# Refine and improve long-term site specific and national science research plans based on needs identified in EM's cleanup strategy and through EM's roadmapping effort. Complete research plans for high-level waste and decontamination and decommissioning in FY 2000 and two additional research plans (for areas such as nuclear materials, and mixed waste).			
Integration of Research Results Into the Program	1,880	1,500	1,500
Small Business Innovative Research Program			
# Assessment on research funds in accordance with Public Law 102-564.			
Small Business Innovative Research Program	0 [a]	765	675
Total, Environmental Management Science Program	45,838	32,000	27,000

Explanation of Funding Changes From FY 2000 to FY 2001

	FY 2001 vs FY 2000 ($000)
FY 1997 Awards	
# Decrease reflects completion, in FY 2000, of research grants initiated in FY 1997	-7,924
FY 1998 Awards	
# Decrease supports mortgages remaining to be funded for research grants awarded in FY 1998	-3,700
FY 1999 Awards	
# Increase supports mortgages related to research grants awarded in FY 1999	6,619
FY 2000 Awards/FY 2001	
# Increase supports mortgages related to research grants awarded in FY 2000. No new basic science grants will be awarded in FY 2001	95
Small Business Innovative Research Program	

[a] $1,162,000 transferred to DOE Office of Science for award and administration of small business grants.

	FY 2001 vs FY 2000 ($000)
# Decrease reflects smaller assessment due to reduction of budget request for Science Program from FY 2000 to FY 2001	-90
Total Funding Change, Environmental Management Science Program	-5,000

Environmental Management Risk Policy Program

Mission Supporting Goals, and Objectives

Program Mission

The mission of the Environmental Management National Risk Policy Program is to develop policies and strategies to manage and reduce risks at the sites and to communicate risk information to stakeholders. The National Risk Policy Program is a partnership between The Center for Risk Excellence, located in Chicago, and the Headquarters Risk Policy Program.

Program Goal

The overall goal of the Environmental Management National Risk Policy Program is to provide guidance, tools, technical support and training that result in credible risk-based environmental decisions which protect human health and the environment and involve meaningful stakeholder participation.

Program Objectives

The Environmental Management National Risk Policy Program will implement its goal by:

- Providing leadership, expertise, and integration of activities to effectively assess, manage, and communicate information on EM risks;
- Promoting the use of emerging science and technology to enhance EM's ability to evaluate and control environmental risks over time;
- Pursuing sound solutions to EM's risk challenges through strategic partnerships internal and external to the Department;
- Involving stakeholders in risk and related issues;
- Partnering with EM offices and stakeholder groups in support of residual risk policy studies and databases to assist EM in decision-making related to managing residual risks to maintain safe conditions and preserve valuable resources into the distant future.

Performance Measures

No quantifiable corporate performance measures are associated with this program. The performance of this policy program is peer reviewed and major reports are peer reviewed.

Significant Accomplishments and Program Shifts

- Providing technical support to EM's field elements to implement a credible site-specific process for risk analysis, risk management, risk communication, and priority setting initiatives.
- Updating and expanding Site Hazard and Risk Profiles to include worker, ecological, and transportation risks and to delineate programmatic risks.
- Providing technical peer review and comments on scientific and technical risk materials, both internally and externally, through nationally recognized scientific and technical organizations.
- Developing and implementing strategies, guidance, and tools for decision-making processes to protect human health and the environment.
- Partnering with others to advocate the use of scientifically valid environmental standards, e.g., standards for cleanup and recycle activities and background levels.
- Coordinating experts from across the complex to develop solutions for specific risk issues, pursuant to a tiered response system that considers requests for assistance based on the urgency of the request and nature/extent of resources required.
- Integrating baseline risk information within a number of key topical risk areas such as residual risk issues and stewardship activities.
- Creating tools and training for project managers to ensure that they can adequately convey risk management tradeoffs to stakeholders, and reach consensus-based decisions.
- Disseminating risk communication publications.
- Supporting and promoting the development and implementation of emerging technologies and cost-efficient, protective measures for reducing risk and mortgage costs.
- Leveraging the risk research supported by other organizations inside and outside the Department of Energy (national laboratories, Environmental Protection Agency, National Institute of Occupational Safety and Health, etc.).
- Support for risk related research to better understand risks at DOE sites and to reduce uncertainties in risk assessment will be completed in FY 2000.

This program supports DOE's strategic goal to aggressively cleanup the environmental legacy associated with nuclear weapons production and civilian nuclear research and development programs, minimize future waste generation, safely manage nuclear materials, and permanently dispose of the nation's radioactive wastes. The program provides guidance and tools to assist the project managers in collection of the information that will ensure that high risk projects are prioritized and funded and that risk to workers, the public, and the environment continues to decrease over time.

It also supports DOE's commitment to ensuring the safety and health of the DOE workforce and members of the public, and the protection of the environment in all Departmental activities.

Funding Schedule

	FY 1999 Current Appropriation	FY 2000 Current Appropriation	FY 2001 Request
National Risk Policy Program	3,000	2,000	2,000
University of Medicine and Dentistry of New Jersey and University of Washington (CRESP) Grant	4,000	3,000	0
Center for Environmental Risk Evaluation (CERE) Grant at Tulane and Xavier Universities	2,000	0	0
Total, Environmental Management Risk Policy Program	9,000	5,000	2,000

Detailed Program Justification

(dollars in thousands)

FY 1999	FY 2000	FY 2001

National Risk Policy Program

The National Risk Policy Program, in partnership with the Chicago Center for Risk Excellence, develops risk-based decision making approaches, including guidance documents and metrics to measure risk reduction to meet goals established for EM under the Government Performance and Results Act and DOE strategic plan.

Continue activities to refine and implement policies and strategies to protect human health and the environment, and continue to involve stakeholders in the risk-based decision-making process. For example, develop new tools for decisions in residual risks.

(dollars in thousands)

	FY 1999	FY 2000	FY 2001
# Implement a process to evaluate risks and hazards associated with the long-term stewardship issues to protect the public and the environment, with issues related to worker safety, and with ecological risk.			
# Update and expand Site Risk Profiles to include risks to workers and the environment; augment profiles according to site and Headquarters' needs.			
# Work with sites to answer risk questions and provide peer review of risk related evaluations and assessments.			
# Maintain a web-based system to provide service-oriented environmental risk assessment expertise using a diverse set of risk tools.			
# Maintain a National Referral System listing academic, industrial, Government, and national laboratory experts in all areas of risk.			
National Risk Policy Program	3,000	2,000	2,000
University of Medicine and Dentistry of New Jersey and University of Washington (CRESP) Grant			
Support a cooperative agreement with the Consortium for Risk Evaluation and Stakeholder Participation (University of Medicine and Dentistry of New Jersey and University of Washington) to perform risk research and develop risk analysis tools to better understand the diverse cleanup risks found at major DOE sites such as Savannah River and Hanford.			
# Cooperative agreement will be completed March 12, 2000.			
University of Medicine and Dentistry of New Jersey and University of Washington (CRESP) Grant	4,000	3,000	0

(dollars in thousands)

	FY 1999	FY 2000	FY 2001
Center for Environmental Risk Evaluation (CERE) Grant at Tulane and Xavier Universities			
Support an award with the Center for Environmental Risk Evaluation (Tulane University and Xavier University) to perform research in risk assessment, risk management, and risk communication. Research to focus on evaluation of risks associated with stakeholder issues, long-term stewardship, and innovative environmental technologies.			
# Activity will not be funded in FY 2000 or FY 2001.			
Center for Environmental Risk Evaluation (CERE) Grant at Tulane and Xavier Universities	2,000	0	0
Total, Environmental Management Risk Policy Program	9,000	5,000	2,000

Explanation of Funding Changes From FY 2000 to FY 2001

	FY 2001 vs FY 2000 ($000)
University of Medicine and Dentistry of New Jersey and University of Washington (CRESP) Grant	
# Decrease reflects completion of Cooperative Agreement for the Consortium for Risk Evaluation and Stakeholder Participation on March 12, 2000	-3,000
Total Funding Change, Environmental Management Risk Policy Program	-3,000